AUTOINTOXICATION
OR
INTESTINAL TOXEMIA

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Preface

In demonstrating the effects of the toxins and ptomains produced by abnormal bacterial development in the intestine, bacteriologists have opened up a new and highly important chapter in the etiology of disease. Even those who were most skeptical, and sometimes violent, in their opposition to the doctrine of autointoxication through absorption of bacterial products from the intestine, have been compelled to admit the dominant rôle played by these highly active poisons. Even eminent German authorities, who for years did their best to laugh out of court the doctrine of Bouchard and his pupils, in recent years have ceased their opposition to the teachings of the French school, although they prefer the term "intestinal toxemia" to "intestinal autointoxication" to designate a general toxic condition resulting from the absorption of bacterial products from the intestinal tract. The change of terms may in fact be desirable as being more strictly correct.

Many German physicians who do not openly acknowledge the correctness of Bouchard's teaching practically accept the principles involved and modify their therapeutic practice accordingly. When in Vienna a few years ago the writer asked an eminent clinician if he thought there was any relation between intestinal autointoxication and a certain chronic malady that was under discussion.

"Oh no," said the professor, "not the slightest. However," he added, "we notice that in cases of this disorder the stools are very foul, and the patient is greatly benefited by a regimen which increases activity of the bowels and changes the character of the stools."

The professor evidently did not like the sound of the French term although he clearly recognized the fact.

At the present time there are few up-to-date medical men who do not recognize the close relation between intestinal stasis, particularly ileac stasis, and a long list of chronic disorders. Internists and surgeons are agreed as regards the etiologic importance of intestinal stasis, but naturally differ in their mode of attack upon the enemy. For example, internists no longer combat arteriosclerosis with nitrites and other pressure-lowering drugs, but assail the enemy in his stronghold by administering paraffin oil and seidlitz powders. Not a few surgeons under the leadership of Arbuthnot Lane have undertaken the cure of a long list of chronic disorders by short-circuiting or removing the colon.

The fact that both internists and surgeons now combat various chronic disorders by measures the general purpose and effects of which are to lessen the absorption of toxic substances from the intestine, is powerful confirmation of the soundness of the doctrine of intestinal toxemia as expounded by Bouchard and such enthusiastic advocates of the doctrine as Metchnikoff, Dr. Tissier, and a long list of other well-known investigators.

There can be no doubt that the ravages of

disease have been checked and most distressing symptoms mitigated in thousands of cases through the use of means for increasing intestinal activity and in some cases by the more radical surgical measures proposed by Mr. Lane. Indeed, the popularity of those health resorts whose sole attraction is laxative water from a spring or artesian well, depends on the enormous demand for means to increase intestinal activity.

These facts bear eloquent testimony to the soundness of the view that intestinal stasis is the fundamental and widespread cause of a large share of the chronic maladies that afflict the people of civilized lands. But that these measures are not highly curative is shown by the fact that medical men are continually seeking for new and better laxative products that will accomplish the desired end without doing harm, and the surgeons are equally active in seeking for better, safer, and more effective surgical procedures. Laxative drugs sooner or later produce colitis and spastic conditions that leave the patient worse than in the beginning.

Very few surgeons are as yet convinced that the elimination of the colon from human beings would be an improvement on the Creator's handiwork; and it is a notorious fact that most of those who have submitted themselves to short-circuiting and even more radical surgical operations for relief of intestinal stasis, sooner or later, usually within a year after the operation, find themselves suffering from the same distressing symptoms for the relief of which they consented to submit themselves to a mutilating surgical procedure.

It is evident that the therapeutic problem presented by a patient suffering from chronic intestinal toxemia is generally conceded to be very difficult of solution. This question is, in the writer's opinion, the gravest problem in therapeutics at the present time before the medical world; and his only excuse for presenting this little volume is the hope that the unusual opportunities for observation and experimentation which he has enjoyed for many years have enabled him to contribute something toward its solution.

The purpose of this work is to present in some detail methods of dealing with cases requiring change of the intestinal flora that have been successfully employed by the writer and his colleagues in the treatment of some thousands of patients at the Battle Creek Sanitarium. All the methods and measures recommended have been thoroughly tried and proven to be efficient in meeting the indications for which they are recommended. The "regimens" which have been worked out as the result of many hundreds of experiments extending over forty years of active practice, if used with the proper precautions, will rarely fail to produce the results expected of them, and generally the results will more than meet expectations.

It is not claimed that diet alone is capable of doing all that can be done in these cases, and it is, of course, expected that other rational measures will be simultaneously employed. But diet is certainly the dominant factor.

Especial prominence is given to the "milk regimen" and the "fruit regimen," because these two have been found most efficient. Various

other useful and efficient regimens have been worked out and are occasionally used.

Although a milk diet has been recognized as a therapeutic measure, and employed in the treatment of various acute and chronic maladies since the time of Hippocrates, its use in this manner even at the present time has been largely, if not altogether, empirical. The rationale of its use has not been understood, and hence it is not surprising that this exceedingly valuable curative means has been little appreciated. The same may be said in relation to the grape and other fruit cures, which from the most ancient times have been more or less in vogue, especially in certain countries. Thanks to the labors of Pavlov, Pasteur, Tissier, Metchnikoff and various other physiologists and bacteriologists there has been developed within recent years the necessary scientific data upon which to base a sound rationale for the "milk regimen," and "fruit regimen" and various other special regimens, and to perfect exact and efficient methods for the employment of these physiologic and remarkably efficient methods of dealing with a class of disorders which have baffled the most persevering efforts alike of internists and surgeons.

Before the discoveries of Pasteur and the researches of Metchnikoff, it was impossible to comprehend the far-reaching and pernicious influence of the "wild" and poison-forming bacteria that infest the colon in most forms of chronic disease. The clinical observations of Poehl of St. Petersburg and the able researches of Tissier, a pupil of Pasteur's, made us acquainted with the remarkable influence of acid-

forming bacteria in inhibiting the growth of putrefactive and other disease-producing organisms in the intestine. Pavlov, Cannon, Elliott, Keith, Case and others have in recent years developed new and most important and illuminating chapters in the chemistry and the mechanics of digestion.

Viewed in the light of these modern researches, the "milk regimen" and the "fruit regimen" acquire a new significance and an importance as efficient curative agents which places them high in the ranks of practical therapeutic means for dealing with nutritional disorders and with that long list of chronic maladies resulting from intestinal toxemias and accompanied by degenerations of various sorts.

While useful in other ways, both the milk regimen and the fruit regimen are chiefly valuable as means for changing the intestinal flora. The failure to recognize this fact and to make the modifications usually necessary for accomplishing this result is the chief cause of the frequent failures which have attended the employment of the milk diet and the fruit diet and which have caused conservative practitioners to hesitate to make use of these physiologic and often brilliantly successful remedies.

One object of the writer in the preparation of this book has been to present what he regards as the true rationale of the milk cure and various other food cures and to point out the modifications of old methods that are necessary to insure uniformly successful results. As modified, the methods employed differ so considerably from

older methods that it is thought best to distinguish them by the term "regimen"; hence the new terms "milk regimen" and "fruit regimen."

The methods recommended in the following pages are not experimental, but have been well tested in the practical management of many hundreds of cases in which the results have been such as to afford no small degree of satisfaction to both physicians and patients.

The chief advantages of the "regimens" herein described are due to the combination of various methods each of which possesses a certain degree of efficiency in itself, but which have not before been brought together in an organized and systematic plan with a clearly rationalized technic.

It should be stated that this work has been prepared with special reference to the needs of trained nurses and busy practitioners who have not time to keep up with the voluminous literature of modern bacteriology and physiologic chemistry, but who are prepared to appreciate the value of well tested methods which produce the results expected of them. The methods presented are based upon the principles and discoveries worked out in the great bacteriological laboratories of the world. Some thirty-five years ago the writer visited the Pasteur Institute in Paris and made the acquaintance of Professor Pasteur, since which time contact with the work of that great emporium of knowledge has been maintained through the monthly *Bulletin* of the institute and occasional visits. For some years the writer has also had the advantage of the counsel of Dr. Tissier, a member of the institute and an associate of Pasteur and Metch-

nikoff. Through Dr. Tissier, special "cultures" have been obtained with details of technic for the growth of useful bacteria and much other useful information and instruction. To this fortunate connection and to the work and writings of Herter, Burnet, Kendall, and Rettger, the author is especially indebted.

I desire also to express appreciation of the careful and laborious laboratory researches conducted by Dr. A. W. Nelson, chief of the Battle Creek Sanitarium laboratory of bacteriology, in checking up the results of a countless number of experiments.

The pages of the text are not lumbered up with references. Neither was it thought worth while to append the names of the long list of works, papers and reports as well as books which have been read or consulted. These are readily available in any large medical library.

Battle Creek, Mich., May 1, 1918.

Preface to Second Edition

Although scarcely more than a year has elapsed since the publication of the first edition of this work, a second edition is already called for, a fact which the writer accepts as evidence of appreciation of the value of the new methods presented in these pages. Additional experience has served to confirm the value of the special methods of changing the intestinal flora, which was for the first time described in this work.

No essential change in technic has been made except in the greater importance attached to the use of the *Bacillus Acidophilus*.

A short chapter on the Rice Regimen has been added at the end of the volume and an extract from a recent paper by Prof. A. I. Kendall which fully supports the views and methods developed by the author by many years of clinical experience and first set forth as a practical method in the pages of this volume. J. H. K.

Battle Creek, Michigan, August, 1919.

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Autointoxication

Bacteria

In order to understand the significance of the processes which result in intestinal toxemia or autointoxication, and the rationale of the methods by which they may be successfully combated, it is necessary to have at least an elementary knowledge of the nature of bacteria and other micro-organisms which are the active cause of the putrefactions and other changes which are known to be associated with intestinal autointoxication.

Although Pasteur was not the first to observe micro-organisms, it is chiefly to his labors that the scientific world owes its knowledge of the lowest order of plants, known in general as bacteria, or in common parlance, germs. These organisms are the lowest of all living forms. They are closely allied to fungi.

Most plants and animals consist of millions of cells associated in an organized body, each group of cells being assigned to some special duty or function. Bacteria are unicellular forms, each microbe consisting of a single cell. There are animal as well as vegetable microbes, but animal microbes are not properly called bacteria.

Bacteria differ from higher plants, not only in the fact that they are unicellular, but also in the fact that they contain no chlorophyl.

In consequence of this inability to prepare food for themselves as do the higher plants, bacteria

are compelled to live a parasitic life, and like fungi, mushrooms, molds and yeast, they feed upon organic substances produced by the vital activities of higher organisms.

Bacteria have many different forms. Many bacteria appear as minute particles. These are known as "micrococci," or "cocci." When these round forms are arranged in groups having the form of strings of beads, they are termed "streptococci." Other groups having the shape of clusters are called "staphylococci." Bacteria that have the shape of long, straight rods are called "bacilli." When the rods are curved they are called "spirilla" and "vibrios."

Some bacteria have long thread-like appendages called "flagella." The flagella of bacteria make active movements by means of which the organism changes its position at a relatively rapid rate. Some organisms move a distance equal to a thousand times their length in a minute. A railroad train going at the same relative speed would travel six thousand miles an hour.

How Bacteria Grow and Work

Bacteria usually multiply by simple transverse division, a form of asexual reproduction. Recently, conjugation has been observed in certain species of bacteria. A curious form of reproduction observed in bacteria is known as autogamy, in which conjugation occurs between two parts of the same cell.

The rapidity with which bacteria grow is almost beyond comprehension. A single bacillus has been known to increase to four millions in

half a day. Pasteur saw a single cell grow to ten millions in twenty-four hours.

The growth of germs is chiefly limited by their food supply and the destructive effects of their own excretions. Left to themselves, even with a sufficient food supply and other favorable conditions, bacteria are likely to die sooner or later —killed by their own excretory products.

Bacteria consume food, as do higher plants and animals. Some bacteria require an enormous quantity of food. The energy derived from the food manifests itself as heat, which serves the chlorophyl-lacking plant in place of the heat derived from the sunlight by higher plants.

The energy set free by micro-organisms manifests itself in the heating of fermenting liquids.

The heating of green fodder in a silo and of manure in a hot bed are examples of energy released by the activity of bacteria. Another illustration of a similar sort is found in the bacteria that fix nitrogen in the soil. The fixation of nitrogen is accomplished at the expense of the consumption of a large amount of carbohydrate, not less than two hundred pounds of carbohydrate being required for the fixing of one pound of nitrogen.

Bacteria, like all living organisms, require oxygen. Some bacteria, for example those that produce lactic acid, as in the souring of milk, obtain their oxygen directly from the air (aerobes), whereas other bacteria (anaerobes) grow without the presence of air or oxygen, and may even be destroyed by contact with atmospheric oxygen. These bacteria need oxygen, but they are so constituted that they must obtain

their oxygen by breaking up compounds containing oxygen.

Certain bacteria can live and grow either in the presence of free oxygen or excluded from it.

The wonderful activity of microbes in breaking up and destroying organic substances is accomplished by means of diastases or digestive ferments, which they often produce in great quantity. Not only bacteria but yeasts and other living cells behave as ferments when deprived of oxygen.

Bacterial Toxins and Pigments

The nature of diastases is not known, but in their presence most remarkable transformations take place—such for example as are seen in the ordinary processes of digestion.

All the digestive changes that take place in the alimentary canal of man and other animals may be produced by the ferments secreted by bacteria. The action of bacteria, however, does not lead to the production of useful substances that may be employed for building up the animal body, repairing its tissues and supporting its activities, but is carried farther and is modified in various ways by special ferments which produce highly poisonous substances. It is in this way, for example, that the toxins of bacteria are produced. Some of these products are the result of the breaking up of the foodstuffs, and others are actual excretions of the micro-organisms.

Some of these toxins possess a degree of virulence or activity surpassing even that of the venoms of poisonous reptiles. For example, it

is known that a single grain of diphtheria toxin is capable of destroying the lives of more than a thousand guinea pigs. Some toxins possess a still higher degree of virulence. A streptococcus studied by Marmormek possessed such powerful toxicity that a single grain was capable of killing seven billion rabbits.

Pigments of various sorts are produced by certain species of bacteria. Some of these are highly toxic. Deposits of these pigments in the skin produce so-called "liver spots," dinginess and bad complexion. One of the most common of these is *brenzcatechin* which according to Combe is formed from animal protein in the intestine, but not from vegetable protein.

Putrefaction poisons named by Brieger and Selmi, are muscarin, cholin, cadaverin, putrescin, neurin, neuridin, saprin, and others. Indol, skatol, mercaptan and other malodorous products are produced by the colon bacillus and other pernicious organisms. There are probably hundreds of poisonous products not yet identified.

Some of the most virulent toxins are produced by streptococci, the small round form of bacteria. These organisms are found constantly present in the saliva and the nasal cavity and cover the skin in countless numbers. Virulent forms often hide in crypts in the tonsils or develop into pyorrhea, a disease affecting the gums. It is now known that rheumatism, neuritis and many other painful and disabling affections are due to invasion of the body by the streptococci of the mouth.

The Influence of Food Upon Bacteria

The observations of Bienstock and numerous other bacteriologists have shown that the character of bacteria may be modified to an astonishing degree by a change of food or culture media; that is, a change of the soil in which the bacterial plant grows, produces remarkable and characteristic changes in the character of the plant and of its products. One of the most notable facts is that most bacteria refuse to grow in the presence of acids. This is particularly true of disease-producing bacteria.

A few bacteria are able to resist acids. These are the organisms that give rise to fermentations, such as the souring of milk and the fermentation of solutions of sugar in the formation of vinegar. The products of bacterial work are always poisonous to the organism by which they are produced. This fact limits the degree of acidity that can be produced by any particular organism.

The *B. Bulgaricus* is remarkable in possessing greater resistance to acids than any other micro-organism known. It will endure a concentration of acids as high as four per cent, whereas few other organisms can resist a concentration much greater than one per cent. This organism will continue to grow in a solution that contains thirty times the amount of acid which will stop the growth of Welch's bacillus, an organism which produces foul gases in the intestine. It is chiefly because of its acid-forming activity that the *B. Bulgaricus* is able to render special service in efforts to change the intestinal flora, as will be shown later.

Sugar Loving Bacteria

Certain bacteria, like the nitrogen-fixing bacteria of the soil, require a large amount of carbohydrate. Malt sugar, milk sugar, dextrose and even cane and other sugars, are greedily seized upon by the sugar loving organisms, many of which are recognized by bacteriologists through the fondness which they show for particular forms of sugar. Sugars of various kinds furnish food par excellence for the bacteria that produce acid fermentation. Most of the colon bacteria are sugar loving organisms, a fact of great significance.

Protein Loving Bacteria

On the other hand, many bacteria thrive best when supplied with a culture media containing an abundance of nitrogenous substances in some form.

These organisms in turn give rise to a destructive change that in organic substances is commonly known as putrefaction. Instead of acids this class of bacteria produce ammonia, ptomains, skatol, indol, phenol, or carbolic acid, and other highly poisonous substances, among which are tox-albumins, which closely resemble and sometimes exceed in virulence the venoms of the most poisonous reptiles.

Some of these nitrogen loving organisms are able to decompose native or raw protein, while others are only able to successfully attack protein that has been partially broken down by the digestive process.

Animal Protein Most Readily Undergoes Putrefaction

Several years ago Doctor Tissier of the Pasteur Institute conducted a research for the purpose of determining the relative activity of these putrefactive bacteria upon animal and vegetable proteins. In a letter to the writer Tissier stated that in general proteins of animal origin are attacked twice as readily by putrefactive organisms as are proteins of vegetable origin. This fact is of great importance and agrees with the observation made by Combe many years ago, that brenzcatechin, a highly poisonous pigment that causes pigmentation of the skin—so-called "liver spots"—is produced only by the action of bacteria upon animal protein.

The Process of Decomposition

The decomposition of organic matter is not a simple process. There are two classes of substances, those which ferment, carbohydrates, and those which decay, proteins. The two classes of bacteria, those that feed on sugar, causing fermentation, and those that decompose protein, causing decay, work together; but the fermentation process starts first because this class of organisms grows most rapidly. Even in meat there is sufficient sugar to start the fermentation process, and so the first symptom of decay in meat is souring. After the sugar is used up the acids are destroyed by germs that feed on them. At the same time, the process of putrefaction is slowly starting through the growth

of the bacteria that feed on protein. Soon the acids disappear, ammonia takes their place, and the odors of putrefaction appear.

Useful or Beneficent Bacteria

Notwithstanding the prodigiously mischievous effects that are justly attributed to the action of bacteria, it must be admitted that they are essential in the economy of life. It is only through the action of bacteria that the great cycle of vital activities that constitute the organic world is made possible. For example, the soil from which plants grow owes its origin to the action of bacteria. It is through bacteria growing in the soil that the nitrogen of the air is fixed and prepared for the use of plants. The extent of this activity, which has not been understood until recent times, is so great as to be almost incredible. No better illustration of the prodigious activity of micro-organisms could be offered than the observations of Muntz and Lainé who found that a peat bed six and a half feet thick and covering an area of twenty-five acres, if inoculated with nitrifying bacteria, might be made to produce the enormous quantity of fifteen hundred tons of nitrate daily. The "frost" that appears in cellars is saltpetre or nitrate of lime formed by the bacteria of the soil (Burnet).

It is believed by some eminent authorities that the great coal beds, and even the extensive deposits of petroleum found buried in the earth, are the result of bacterial action. It is certainly known that it is only through the action of bacteria that the dead bodies of plants and animals

are returned to the soil through the processes of fermentation and putrefaction. Except for this beneficent action of the bacteria the soil would sooner or later become exhausted and the earth would be encumbered with the desiccated forms of plants and animals which had finished their life history. It is thus only through the action of bacteria that the cycle of organic activity is maintained.

Another and notable example of the utility of micro-organisms was brought to light through the remarkable discovery of Tissier, made known to the world by Metchnikoff, that the acid-forming bacteria which are active in fermentation, may be successfully used to combat the poison-forming bacteria that are active in the processes of putrefaction. Fermentation and putrefaction are antagonistic processes. Fermentation produces acid products which are for the most part harmless to human beings but inimical to putrefactive bacteria.

This wise provision is of greatest importance in the economy of nature. Vegetable foods contain sugars, starches and dextrines, substances which ferment, and so when undergoing decay do not in general give rise to the obnoxious and poisonous gases and other substances which accompany the decay of animal tissues.

Milk likewise ferments because of the large amount of sugar which it contains. Eggs and meat do not ferment but undergo putrefaction giving rise to highly offensive and poisonous products. This is because of the absence of sugar. Eggs or meat placed in a strong solution

of sugar will not decay. Sugar is thus a preservative.

Another useful employment of fermentation is in the production of silage. The silo is a device for fermenting green stuffs and so preserving them from destruction and providing green food for cattle during the winter months.

Bacteria Are Everywhere

It is difficult to find a spot on the earth's surface where bacteria do not abound. They are most abundant in the air of crowded cities, but also are found in the air of mid-ocean. The air of high mountain tops is comparatively free from bacteria as also the air of the Arctic regions. Even the sea water near the poles contains few microbes. Bacteria grow with great rapidity in the warm moist climate of the tropics, but fortunately their development in hot countries is greatly hindered by the disinfecting effects of the actinic rays of the tropical sun.

Bacteria of the Skin

Bacteria which are capable of infecting the body cells and causing suppuration are constantly found upon the skin in countless numbers. These round streptococci infest especially the oil glands of the skin and the hair follicles. The so-called "skin worms" or comedones consist chiefly of colonies of bacteria.

The Intestinal Flora

The plants which grow in a locality are known as its flora. Bacteriologists have applied the same term to the various species of low vegetable forms known as bacteria that grow in the alimentary canal.

The flora of every locality may be divided into two classes, one useful, the other useless or pernicious.

The group of useful plants comprises food plants, flowers, trees and other plants that may be in some way utilized. The second class is made up of weeds, poisonous or useless plants.

A similar classification may be made of the intestinal flora. Certain species are useful and native to the alimentary tract, the acid formers. These render useful service to the body by preventing the growth of the harmful bacteria.

Another class, sometimes known as "wild" bacteria, or "meat bacilli," give rise to various harmful effects through poisons that they produce and in other ways.

The entire alimentary tract harbors multitudes of bacteria. The saliva swarms with bacteria which are ready to develop enormously if favorable conditions are supplied, and may attack the teeth and the gums, as seen in dental decay and pyorrhea. So long as the blood is maintained in a state of high resistance the saliva protects the mouth and the teeth by inhibiting or hindering the growth of bacteria; but when the blood becomes deteriorated, the saliva loses its protective power, the mouth germs become more numerous

Gas-Forming Organism, *B. Welchii* (Hicks)

Colon Bacillus

INTESTINAL BACTERIA

and more virulent, the tongue becomes coated and the breath foul, and the teeth become coated with a viscid mucus and finally show evidence of decay. Roger and others have isolated many different species of bacteria from the saliva.

The cavities of the nose and throat likewise harbor many species of bacteria—not only the common pus-forming microbes, streptococci and staphylococci, but the dangerous micro-organisms of pneumonia, diphtheria, and meningitis.

Many of the species of bacteria found in the mouth are also found in the stomach. Fortunately the stomach is protected by the gastric juice, which is a powerful disinfectant so long as it contains the normal amount of hydrochloric acid. The normal stomach always contains enough gastric acid to protect it. The diseased stomach, however, often lacks this important means of defense.

When this is the case, the bacteria of the mouth easily pass through the stomach and establish themselves in the intestine, where they find conditions more favorable for their growth and development, especially in the colon.

Roger enumerates one hundred and sixty different species of microbes that infest the alimentary canal, more than one-third being known to produce poisons. The largest number of these various species are found in the colon, where conditions for the growth of bacteria of the worst kind are most favorable. Here the unusable residues of the food, together with mucus, bile, and other body wastes, furnish just the material best suited to encourage the growth of

putrefactive and other disease-producing bacteria.

The presence of these dangerous enemies of life and health is made obvious by the highly offensive and often loathsome character of the stools or bowel discharges. Putrid, rancid, ammoniacal, nauseating odors always indicate putrefaction, and from the intensity of the foul odors may be judged the intensity of the putrefactive process.

How the Intestine Becomes Infected

Bacteria are so constantly present everywhere the wonder is, not that the intestine becomes infected, but that the body is not more quickly and more often overwhelmed by these parasitic enemies of life. The air we breathe, often the water we drink and the food we eat, swarm with bacteria or their spores.

Through the medium of unwholesome food and various errors and accidents the alimentary canal becomes infected with putrefactive organisms and other poison-forming and disease-producing microbes. The most virulent and active of these are naturally introduced in connection with animal protein. Stale eggs, oysters, and especially smoked or salted fish, "prime beef," game, certain varieties of cheese, commercial cow's milk and butter are common sources through which the so-called "wild bacteria" are introduced into the body. Many persons can distinctly trace the beginning of years of suffering from conditions dependent upon intestinal toxemia to an acute poisoning from

canned fish, "over ripe" game, cold storage eggs, or sausage.

"Meat Bacteria"

It will probably be news to some people that all butcher's meat contains bacteria, putrefactive germs in vast numbers. Tissier, of the Pasteur Institute, found that "meat taken from the slaughter house as fresh as possible contains all the germs necessary for putrefaction."

Meat is, in fact, even under most favorable conditions, the most unclean thing that comes upon our tables. This naturally results from the fact that a dead animal, like a dead person, is a corpse. A dead body rapidly undergoes putrefactive changes.

In papers read before the 1913 meeting of the American Public Health Association, Weinzirl and Newton presented an improved method of making bacteriological examinations of meat, and showed that butchers' meat is swarming with putrefactive bacteria long before its odor or appearance shows any evidence of decay. As many as 2,640,000,000 bacteria to the ounce were found in hamburger steak that "would pass muster" under ordinary sanitary inspection. In only four out of forty-four samples was the number of bacteria less than 30,000,000 to the ounce, the average being more than 460,000,000 to the ounce.

Some years ago, Marxer, a recognized authority, found that market meats that easily passed the ordinary inspection tests often contained more than 30,000,000 bacteria to the

ounce. In the case of hamburger steak it was found that more than half the samples offered in the market contained 30,000,000 bacteria to the ounce or more.

Marxer took the ground that meats containing as many as 30,000,000 bacteria to the ounce should be condemned as unfit for food. This would, of course, rule out such meats as hamburger steak, prime meats and most game. It was argued most consistently that it is unreasonable to condemn milk that contains 6,000,000 bacteria to the ounce and not condemn meats that contain five times as many bacteria. Such action appears still more inconsistent and indefensible when the fact is considered that "meat bacteria" are for the most part putrefactive organisms, poison producers, capable of producing infection and disease, whereas the bacteria of milk are almost altogether harmless, lactic acid-forming, or so-called "buttermilk germs."

Nothing could be more absurd from a scientific standpoint than to take great pains to secure a clean milk supply, such as certified milk with a maximum bacteria count of 300,000 buttermilk bacteria per ounce, and then swallow along with it meat containing from a hundred to a thousand times as many germs and bacteria of a most pernicious and loathsome kind.

Before another half century has passed, we shall have become sufficiently civilized to reject from our tables things that are only proper food for hyenas and turkey buzzards.

According to Ostertag, School found in a steak that had been lying for two days so many

putrefactive toxins that a watery extract made at a temperature of 104° F. killed a guinea pig by paralysis in two hours. Such extracts will often kill guinea pigs, in doses of one or two c. c. (one-fourth to one-half dram).

A second series of samples collected by the authors showed an average of 3,000,000,000 bacteria to the ounce. Nine samples collected in summer averaged 6,000,000,000 to the ounce. All the samples of this series had the familiar *haut gout* characteristic of "prime beef" and wild game, the true "gamey" flavor so much relished by gourmands.

Meats contain a small amount of sugar. In the decomposition of meats the sugar is attacked first. The acids formed delay the development of putrefaction, but when the sugar is consumed putrefaction begins, ammonia neutralizing the acids present. The alkalinity now encourages putrefaction, which progresses with great rapidity. Meats offered in the market have already passed through the first stage of decomposition and are well advanced in the process of decay. Dried and salted meats and bologna sausage are always teeming with putrefactive bacteria.

Some years ago, at the request of the writer, Nelson, bacteriologist, made an examination of various meats obtained from the market and found that such meat contained from 500,000,000 to 20,000,000,000 bacteria to each ounce.

According to Ostertag*, in meat which had been

*Ostertag's Handbook of Meat Inspection, translated by Wilcox.

preserved in ice for two weeks, Forster found millions of bacteria in a single milligram of the surface substance. This would mean scores of billions in an ounce of such meat. According to the same authority, Presuhn found colon bacilli deep in the substance of the liver after twenty-four hours. Mice inoculated with the cultures died in twenty-four hours.

Smoked or salted fish, certain varieties of cheese, commercial cow's milk and butter are common sources through which the so-called wild bacteria (Herter) are introduced into the body.

Oysters and shell fish of all kinds are swarming with bacteria. A bacteriological examination of oyster juice shows it to be crowded with bacteria. Not infrequently typhoid bacilli are found in the stomach and intestines of the oyster, as well as in the juice. Oyster juice has the composition of urine, which is natural, since the kidneys and intestine of the animal remain active so long as it is alive.

A so-called "bilious" attack or typhoid infection may likewise be the starting point of chronic toxemia. In the majority of cases, however, infection of the intestine by "wild" bacteria develops slowly, and in most if not all human beings begins at an early age.

The facts known concerning bacterial action in the colon are thus briefly summarized by Schmidt:

"Fermentation of carbohydrates takes place normally, both in the lower part of the small intestine and in the colon. *Putrefaction of*

protein, on the other hand, occurs exclusively in the large intestine. The ileocecal valve forms a sharp line of demarcation, above which putrefaction of protein never occurs, except under pathological conditions. In the cecum and ascending colon, which are the sites of the most active decomposition, both fermentation and putrefaction take place together; the latter afterwards outruns the former, to decrease again in the last portion of the colon, where the feces become inspissated."

The development of toxemia is especially favored by habitual constipation. When delay occurs in the movement of the intestinal contents carbohydrates are entirely absorbed; as a result the acid-forming bacteria which normally protect the intestine against the wild or poison-forming bacteria are starved and soon die.

Cooked food yields much more readily to bacterial action than does uncooked food.

Putrefaction is very greatly facilitated in the large intestine by the presence of great numbers of putrefactive organisms as well as by the warmth of the body. An uncooked beefsteak placed in an incubator at the temperature of the body, becomes in a few hours far advanced in decomposition. The same thing happens to particles of beefsteak or other meats that, incompletely digested and hence unabsorbed, reach the colon from the small intestine. Ordinary cooking does not destroy putrefactive bacteria. Many of these organisms produce spores which require a temperature of at least 240° F. for half an hour for their destruction.

We may recall the fact that the diet of primitive man, like that of the chimpanzee, orang-utan and other higher apes at the present time, consisted of the natural products of the earth. Cookery is an artificial process, and in the light of modern discoveries can not be regarded as an unqualified blessing. It has recently been shown that cooking destroys vitamines, highly subtle substances that have been shown to be essential to perfect nutrition, and the absence of which gives rise to such well-known disorders as scurvy, rickets, beri-beri and perhaps pellagra and other disorders.

Intestinal stasis, or constipation, causes intestinal toxemia, not only by giving an opportunity for absorption of the toxins that have been formed, but also by retaining decomposable material in the colon, which, through the complete absorption of the protective carbohydrates, gives the putrefactive organisms an opportunity for prompt and luxuriant growth.

The fact that in many cases of extreme constipation the fecal matters have very little odor is not evidence of the absence of putrefaction, but rather is evidence that the putrescible material has been exhausted and the putrefaction products absorbed. It is only necessary in such cases to give the patient a laxative to find in the loathsome smelling stools that result abundant evidence of the active putrefaction taking place in the upper portion of the colon.

The introduction of "wild" bacteria into the intestinal tract alone will not give rise to chronic intestinal toxemia. The protective forces of the

body are capable of dealing with infections of this kind so long as the bodily functions remain normal. In a person with normal secretions and with a colon that empties itself with the normal intestinal rhythm, evacuating its contents three times a day, wild bacteria would not be able to obtain a foothold. The few bacteria introduced, if not destroyed in the stomach or captured by the myriads of leukocytes that they would meet during transit of the alimentary tract, would be dismissed from the body before they had an opportunity to develop in any considerable numbers by colonizing in the folds or pouches of the colon.

The poison-forming organisms always find in the colon an abundance of protein in the form of mucus. In the residues of internal secretions, as well as unabsorbed food proteins, these organisms grow luxuriantly, so that in the course of years a considerable variety of putrefactive and other mischief-making organisms are accumulated. Every new infection makes a new contribution of injurious organisms that become domiciled in the intestine and continually flood the tissues with their virulent products, some of which are highly active in most minute quantities.

According to Spence, urobilin (formed by the putrefaction of bile) must be included with skatol, indol, phenol, cresol and other poisonous products of intestinal putrefaction. Says Magnus-Levy, "The classic research of Jaffe and Nencki has shown that these bodies are not present in the small intestine, confirmed by A.

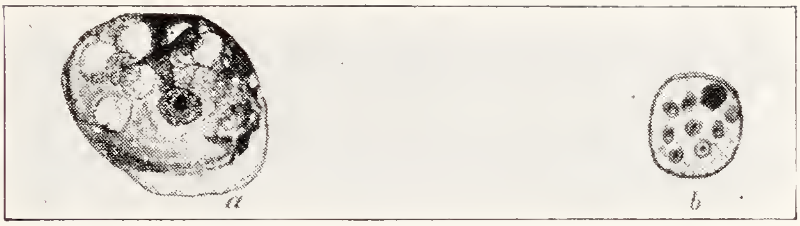
Schmidt and others. They originate, therefore, in the large intestine, in which the micro-organisms have the necessary time to produce abnormal decompositions. This fact has become of importance for the recognition of many intestinal troubles."

"As a rule, the formation of urobilin in health takes place exclusively in the upper part of the large intestine (Macfadyen, Nencki and Sieber, A. Schmidt, Schlorlemmer). Here the conditions do not appear to be especially favorable for its absorption." (Weintrand) Urobilin seems thus to do little harm so long as it is confined to the large intestine where it is produced. But when the ileocecal valve is incompetent, the urobilin is forced back into the small intestine and is there quickly absorbed along with other poisons.

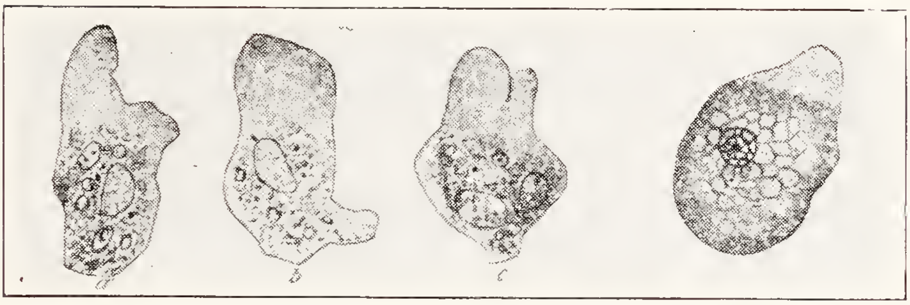
Are Intestinal Bacteria Essential to Life?

The rootlets of plants are surrounded by bacteria that perform a useful office for the plant by fixing the nitrogen of the air and converting it into compounds that the plant can use in the manufacture of protein and plant protoplasms.

Bacteria are evidently necessary for the promotion of plant life through the making of soil and the fixation of nitrogen, although it was long ago shown by the Pasteur Institute that some plants may grow in a perfectly sterile medium. Do bacteria perform an equally useful service for animals, or is their presence in the alimentary canal to be looked upon as an unfortunate



Amœba Coli



Amœba of the Mouth

Bodo-Grassi (Hartman)

INTESTINAL FAUNA—PROTOZOA

(Animal Organisms)

accident—a condition to which the body has been obliged to accommodate itself, although not without suffering serious disadvantages? The studies of Tissier and Metchnikoff and numerous others have demonstrated that bacteria are not essential to animal life, notwithstanding the fact that they are commonly found present in the intestines of animals. The presence of bacteria, in other words, is in a sense accidental and in no way essential to life.

It is true, as already pointed out, that the intestine is invaded by acid-forming bacteria within a few hours after birth. But this seems to be a defensive arrangement that has been developed for the purpose of protecting the young organism against the destructive effects of putrefactive organisms that otherwise would quickly take possession of the whole digestive tract.

Pasteur held that animal life without bacteria would be found impossible but he did not undertake to test his theory by actual experiment. Experiments made by various investigators have not confirmed the views of Pasteur but have shown the opposite to be true.

Metchnikoff has long maintained that the colon bacilli are not helpful, but in the highest degree harmful, producing, through their pernicious influence, hardening of the arteries, premature old age, and numerous degenerative disorders of the heart, liver, kidneys, and other vital organs.

Fortunately the animal world furnishes a sufficient number of examples of animal organisms

which exist, either the whole or a part of their life-cycle, without the presence of bacterial life in their interiors.

Certain animals, as has been pointed out by Metchnikoff, are naturally free from bacteria. Among these are the large fruit eating bats of the tropics. These animals have very short colons and begin to evacuate the unusable remnants of food an hour after it has been eaten. The material does not remain long enough to permit of any fermentative changes. The digestive juices of these animals are found to be incapable of destroying bacteria. Their intestines are free from bacteria simply because they live upon food that contains no bacteria and discharge the unusable remnants of their food before there has been time for bacteria to develop. No putrefactive products are found in the feces of the fruit-eating bat; that is, they contain no phenol, skatol or indol.

The scorpion affords another example of an animal whose intestine contains no microbes. The same is also true of certain maggots which are provided with digestive juices which are able to digest wool, seeds, and the most resistant microbes (Burnet).

A study of Arctic animals at Spitzenberg by Levin showed that the intestines of more than half the animals examined were free from bacteria.

The larvæ of various insects that burrow in thick leaves live without contamination by bacteria.

Many caterpillars are perfectly aseptic. A

caterpillar that frequents rose trees—*Nepticular*—is always free from bacteria.

Wollmann succeeded in breeding sterile flies from aseptic larvæ.

Nuttall and Thierfelder reared guinea pigs without bacteria.

Says Burnet, of the Pasteur Institute, a pupil of Metchnikoff, "From the point of view of nature, it is quite normal for the albuminous excreta of our food to putrefy and thus return into the general circulation of matter; but it is regrettable when this takes place in our bodies, for phenols, skatol, and indol, among other products, penetrate into our circulation and affect the cells of our arteries and brain. It would be to our advantage if the food-stuffs were expelled immediately after useful digestion, and before the terminal phase, the putrefaction, begins in the waste products. And since in the part of the intestine, which properly speaking is the digesting part, the small intestine, there are practically no bacteria, and since, on the other hand, they swarm in the large intestine where there are scarcely any digestive ferments, it is evident that, on the whole, the intestinal flora is injurious. The ideal condition would be to live free from bacteria while the world remained populated by them. Is a life of such purity possible?"

The Normal Flora

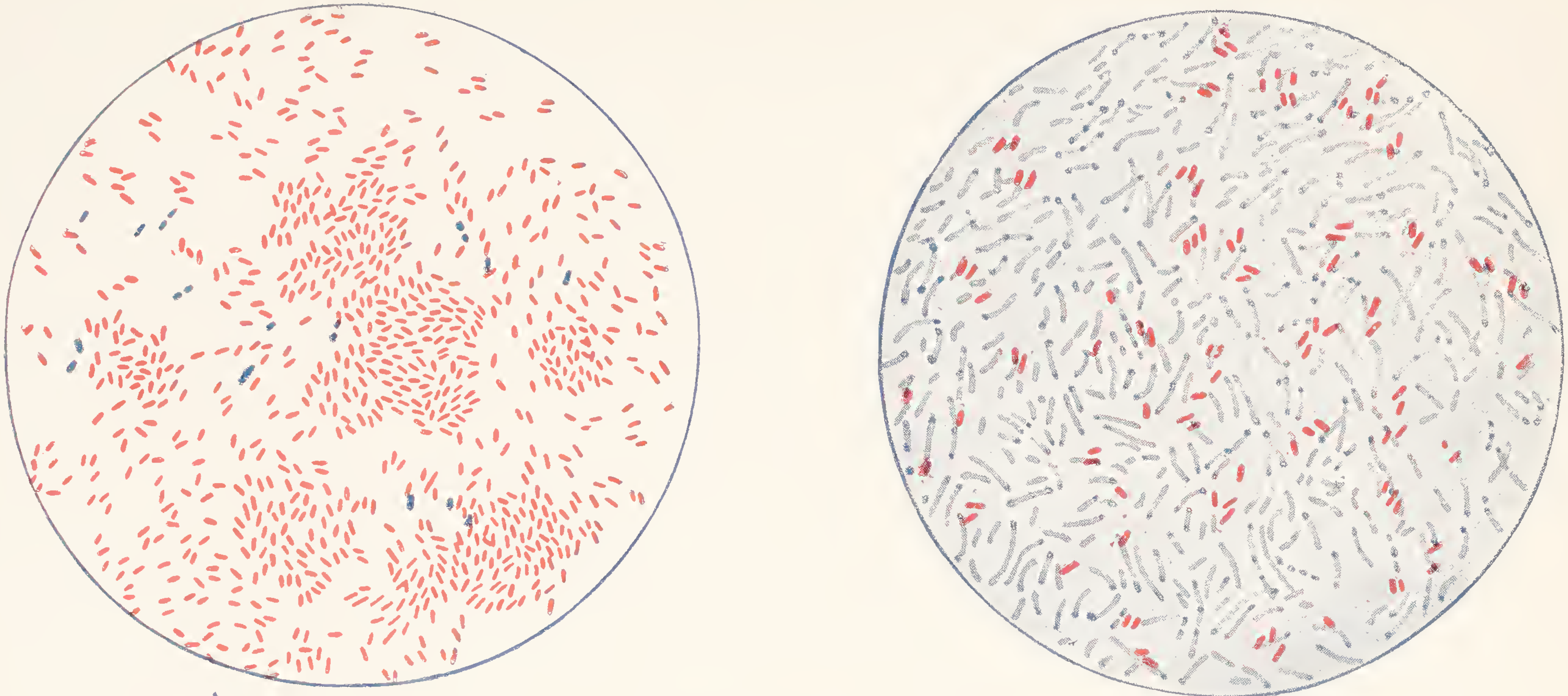
Probably not, under the ordinary conditions of human life. We live under a great handicap that shortens our lives and subjects us to end-

less miseries and tortures. Nature has, however, to some degree provided a defense against this great menace to life and health by supplying us at birth with a beneficent flora that is able to protect us against the attacks of the pernicious invading organisms.

Tissier showed that soon after birth the intestine of the infant is occupied by bacteria that produce harmless acids, the ordinary acids of sour milk. These bacteria are dominant so long as the infant nurses at the breast and is properly cared for. These acid formers are properly termed the normal intestinal flora. By a wise provision of nature they take possession of the intestinal tract immediately after birth, and there is every reason to believe that if these acid formers retained undisputed possession of the intestinal tract the span of human life would be extended very greatly beyond the present age limit and humanity would be saved from a vast multitude of physical, mental and moral disorders and miseries.

Why the Stools of Healthy Infants Are Not Putrid

"In the normal stools of healthy infants," according to Czerny and Steinitz, "sugar is either absent, or only present in very small amount (Wegscheider, Uffelmann, Blauberg). It must not, however, be concluded from this fact that sugar is completely or almost completely absorbed. According to our present knowledge a certain, by no means negligible, amount is decomposed by the fermenting agencies in the intestine, and escapes absorption. The products of



A B

Colon Bacteria

The red color indicates species which produce putrefaction and give rise to toxins; the blue color, acid-forming organisms which are friendly. A. Stool from a child suffering from intestinal toxemia. B. Same case ten days later after flora was changed by a change of diet and other measures.

its decomposition serve to maintain the acid reaction of the intestinal contents, which for their part, secure a normal bacterial growth and normal peristalsis of the intestine.

"Normally, in the intestines of infants no putrefactive processes occur. According to Senator, putrefaction is prevented by the rapid passage of the food through the gut. This being the case, the feces, if left to themselves, should putrefy outside the body. As a matter of fact, this does not happen."

Food is to the body what earth is to plants. The food is the soil out of which the body grows. The four million villi of the small intestine are the rootlets which suck up the nutrient material prepared by the digestive ferments to nourish the tissues. If with this nutrient material are mixed poisonous substances, the natural result is the manifold disturbances of the bodily functions and the varied degenerative processes, which through the labors of Bouchard, Combe, Roger, Brieger, Tissier and a host of other observers, have been shown to arise from the condition known as "intestinal toxemia." Prominent among these disturbances may be named, not only various gastric intestinal disorders, including gastric and duodenal ulcer, cholecystitis, cholelithiasis, pancreatitis, colitis, appendicitis, acute and chronic diarrheas and dysenteries, but also the grave disorders that are due to organic changes such as cirrhosis of the liver arteriosclerosis, myocarditis, Bright's disease, cardio-vascular renal disease, and probably diabetes.

Modern experimental agriculture has shown that the ordinary soil often becomes so deteriorated through bacterial infection that its fertility is greatly impaired. The up-to-date greenhouse man sterilizes his soil periodically, by so doing doubling its productivity. Several methods are in actual use for the sterilization of the soil for the growing of ordinary farm crops, the increased production being found to be amply sufficient to repay the large expense involved. The subtle toxins produced by bacteria that infect the soil, dwarf the development of the growing plant and lessen its resistance, and thus prepare the way for blights of various sorts that are harmless to the more hardy and vigorous plants that grow out of a clean uncontaminated soil.

The soil out of which the body grows needs to be changed or restored to its normal condition for the same reason that the soil of the greenhouse or farm needs changing. Unfortunately, however, the process is a much more difficult one.

Do Bacteria Penetrate the Intestinal Wall and Enter the Blood Current?

Do bacteria penetrate the intestine? It is well known that in typhoid fever and other infectious diseases, in which the infective agent enters the body through the alimentary canal, bacteria are found, not only in the intestine, but in the blood and in all parts of the body.

Until recently it has been believed that in health bacteria do not penetrate the intestinal

wall, although the experiments of Ficker showed that the resistance of the body may be so diminished by fatigue and hunger that bacteria will pass through the intestinal mucous membrane.

It is now known, however, that bacteria are constantly entering the circulation from the intestine. The blood of the portal vein always contains bacteria, especially after meals, when absorption is most active. In the passage of blood through the liver most of these bacteria are destroyed or passed out in the bile, so that they do not in large numbers pass into the general circulation, except when taken in unusual numbers, or when the liver has become crippled and so no longer able to perform its defensive work.

Bacteria are often found in the urine in great numbers, having been eliminated from the blood by the kidneys after having escaped removal by the liver.

The gall-bladder often becomes an incubating chamber for bacteria. Gallstones are the result of the action of bacteria. Typhoid bacilli have been found in the gall-bladder many years after recovery from an attack of the fever.

Is Intestinal Putrefaction a Necessary Evil?

That nature intends the human alimentary tract to be free from putrefactive changes is evidenced by the pains she takes to prevent the development of putrefactive changes in the intestine and to protect the body against the products of decay when changes of this sort occur.

Every human infant—in fact, every young animal—is born sterile. The delicate processes of growth and development can be carried forward in a normal way only in the absence of the venomous poisons that are produced by the bacteria that give rise to putrefactive changes. The intestinal discharges of a new-born infant or a new-born animal of any kind are absolutely free from germs.

Within four to six hours in summer and ten to twenty hours in winter bacteria appear in the intestinal discharges. They work their way in from both directions—through the mouth and the anus. In a few days a very rich flora is found in the stools.

Most remarkable and worthy of special note is the fact that these swarming micro-organisms are all of a special kind. None of them are capable of producing putrefaction. They are acid formers—that is, they give rise to fermentation and produce acids.

It is agreed by physiologists that putrefaction of the intestinal contents does not occur in normal conditions. The colon is the waste receptacle of the body. Into it are thrown by peristaltic action, the unusable residues of the food. Nature protects the body by providing a normal intestinal process which maintains a fermentation in the colon, producing acids which stimulate the colon to action; without this fermentation putrefaction would occur with the production of ammonia and other "bacteria" and thus paralyze the colon and cause constipation.

How the Body Defends Itself

Life is one continual battle between the body cells and the bacteria that swarm upon and within it. The bacteria are constantly endeavoring to work their way into the interior of the tissues from the skin and the intestine, where they are constantly present in countless numbers.

Their efforts are thwarted by the living cells which they encounter. White blood cells swarm out from the blood vessels to meet and repel the invaders. Whenever, by accident or otherwise, bacteria obtain a foothold in the tissues there is at once a great increase in the white cells of the blood, especially of the microphags. After death the parasitic microbes meet no resistance. Within a few hours the whole body is swarming with the bacteria that have worked their way in from the skin and the intestine.

Shortly before death bacteria enter the blood in great numbers and are thus rapidly distributed.

The Mucous Membrane a Living Barrier

Several lines of defense are maintained by the body against the micro-organisms that attack it through the intestinal canal and against the poisons which they produce.

The colonic mucous membrane vigorously resists the attempts of bacteria to penetrate the blood vessels and lymphatics. Its living cells

swallow and destroy millions of bacteria daily. The slightest abrasion, however, opens the way for the easy entrance of virulent microbes. For example, Pasteur found that sheep took anthrax when they were fed with the spores of this microbe mixed with small splinters. The splinters produced small wounds in the mucous membrane through which bacteria entered. The mucous membrane also retains certain poisons and excludes others.

A congested or abraded mucous membrane, such as exists in colitis, and such as results from the use of laxative mineral waters and other aperients and cathartics, cripples the defensive cells and opens wide doors for the entrance of harmful bacteria and bacterial poisons.

Defensive Action of the Blood

In the blood, bacteria encounter the white blood cells, some forms of which, as first shown by Metchnikoff, have for their function the destruction of bacteria. These cells—the so-called "neutrophiles" and "small lymphocytes"—are always greatly increased in cases of pronounced intestinal toxemia. They are increased in ordinary cases of constipation. This condition favors the entrance of bacteria into the blood.

These germ-destroying blood-cells are also increased after the use of a cathartic to unload the intestine. This is doubtless the result of the congestion produced by the drug, and the consequent diminished resistance of the mucous membrane. The most highly poisonous of the

toxins produced in the alimentary canal are certain tox-albumins which resemble the venoms of snakes in their virulence. The healthy mucous membrane is almost wholly impervious to these highly active poisons; but the congested or abraded intestine permits them to pass into the circulation. This fact accounts for the distressing symptoms experienced by some persons after taking a cathartic.

In the blood are found various alexins, sozins, and other bodies that combat the invading bacteria.

Defensive Action of the Liver

The liver, as already explained, combats bacteria by destroying and eliminating them. It also destroys to some extent the bacterial poisons that get through the mucous membrane. Certain poisons,—such as skatol, indol, and phenol—are distoxicated by combination with sulphuric or acetic acid. Glycuronic acid is also formed from sugar or glycogen, and is used for the same purpose. It is doubtless for this reason that a good store of glycogen in the liver is essential to insure its efficient functioning as a poison-destroying organ. Glycogen is formed from carbohydrates. A liberal supply of carbohydrates is thus essential to maintain body resistance.

Roger maintained that the bile modifies poison-forming bacteria so that they are unable to produce toxins. It is also known that the bile prevents the growth of many harmful bacteria, although it does not actually destroy them. It was noted, however, by Roger, that the bile in-

creases the toxicity of bacterial poisons which have already been produced. This explains the relief which many people experience after the removal of a large quantity of bile from the stomach by vomiting or the use of the stomach tube, or even by means of a dose of calomel or a large dose of salts or laxative mineral water. Lauder Brunton many years ago called attention to the fact that the bile from a biliary fistula is quite different from ordinary bile, lacking its bitterness and probably much less highly toxic. Ordinarily the bile is in large part reabsorbed from the intestine, and hence becomes concentrated. In cases of biliary fistula absorption does not occur.

Years ago Roger, the brilliant pupil of Bouchard, showed that the liver cells destroy poisons brought to it in the blood. Some poisons are actually burned up by oxidation; others are distoxicated and rendered harmless.

"Lauder Brunton showed that the liver destroys the toxin of diphtheria, and Dixon and Lee showed that the tolerance to tobacco shown by smokers is due to the fact that the liver destroys the nicotine." If the liver possessed an unlimited capacity the use of tobacco could do no harm. But its protective power is limited. When the limit is reached, the smoker begins to note ill effects.

Other Defensive Means

Other poison-destroying organs are the thyroid gland, probably the lymphatic glands, and especially the suprarenal capsules. An important special function of the last named glands is to destroy certain poisonous pigments which are pro-

duced in the putrefaction of animal proteins in the intestine.

The kidneys and the skin eliminate germs probably in much greater numbers than is generally supposed. It is on this account that attention must be given to the excretions of the skin and the kidneys, in cases of typhoid fever, as well as the stools, to prevent infection.

The Ileocecal Valve

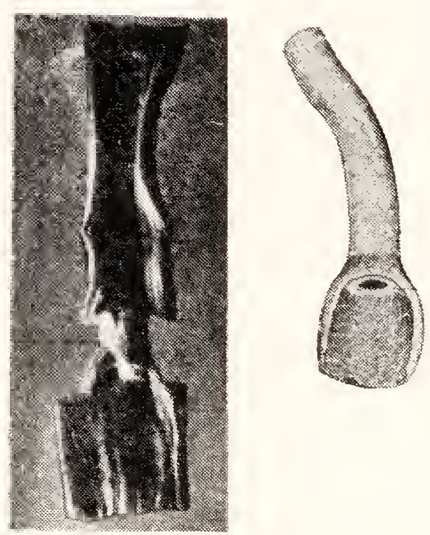
Nature has provided a remarkable means of defense against the bacteria and bacterial poisons developed in the food residues found in the colon by placing at the junction of the small intestine with the colon a check valve so ingeniously contrived that nothing that has once passed into the colon can get back into the small intestine. Even gas, as well as solids and liquids, is effectively confined to the colon. This is necessary for the reason that the colon is better prepared to deal with germs and their poisons than is the small intestine. Absorption from the colon takes place very slowly. Not more than one-twentieth as much fluid is absorbed from the colon as from the small intestine.

Adolph Schmidt called attention years ago to the relation of ileac stasis to intestinal toxemia. Schmidt remarked that putrefaction in the colon did not give rise to the presence of indican in the urine in any considerable quantity, and that the presence of much indican in the urine was due to the reflux of putrefactive material from the colon into the small intestine through an incompetent ileocecal valve. The study of the clinical histories of some hundreds of cases in which Dr.

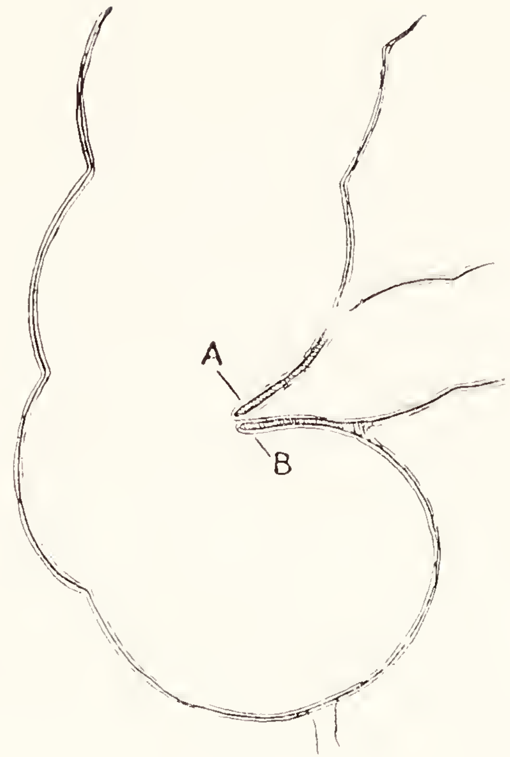
J. T. Case has proved the ileocecal valve to be incompetent by x-ray examination has convinced me of the accuracy of Schmidt's observation, which is all the more remarkable, since at the time his statement was made the x-ray means of diagnosis of incompetency of the ileocecal valve had not yet been developed. It seems probable that in practically all cases of intense intestinal toxemia the ileocecal valve is incompetent.

Carrel's Remarkable Experiments

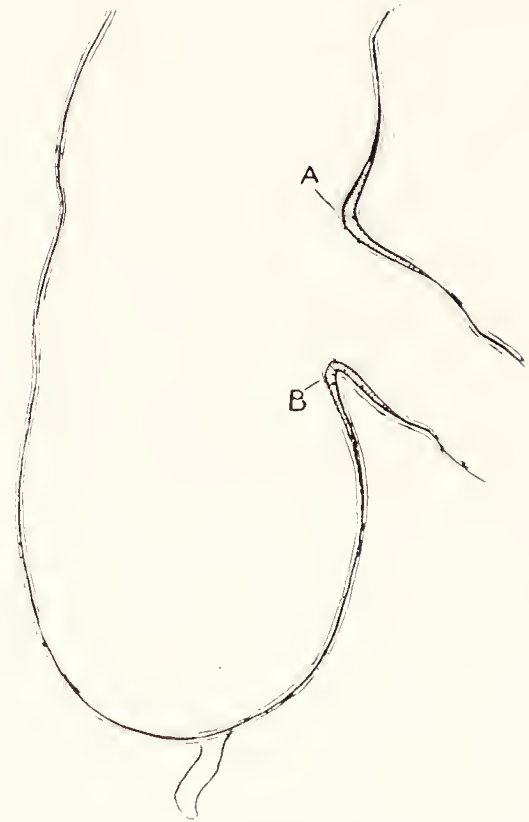
Carrel, of the Rockefeller Institute, made a remarkable experiment that clearly demonstrates the influence of toxins upon living cells. Carrel demonstrated that living tissue of various kinds could be made to grow in a suitable medium. He observed, however, that after a few days the rate of growth was slowed, and ceased at the end of a couple of weeks. His experiment would have ended here but for the interesting discovery that by changing the nutrient media, so as to wash away the poisons which the tissues had produced, he was able to extend this period of growth for another two weeks. By renewing the nutrient media and thus cleansing the growing tissue of its waste products every fourteen days, Carrel was able to extend his remarkable experiments for many weeks. The rapid rate of growth gradually diminished, however, until finally growth ceased and the death of the living cells terminated the experiment. This is exactly what takes place in the body as the result of the poisoning of the living cells with the poisons absorbed from the intestine. So



Ileocecal Valve of Fish
(Huntington)



Competent



Incompetent

ILEOCECAL VALVE

long as the body is able to keep itself free from poisons the vitality of its tissues is maintained; but when the liver, kidneys and other excretory organs begin to fail, poisons accumulate, degenerations begin, senile changes make their appearance, and death ends the scene.

The influence of the poisoning-destroying glands in protecting the body was well demonstrated by a modification of the above experiment, in which Carrel applied the juice of thyroid gland or spleen of a very young animal to the growing tissue. The effect was most astounding. The rate of growth was stimulated to such a degree that the tissue increased in twenty-four hours to forty times its original bulk. Carrel was thus enabled by the use of thyroid juice, not only to prevent the degenerative influence of the tissue poisons shown in the gradual slowing of growth and finally death, but to produce an opposite effect—increasing the rate of growth and apparently making it possible to continue his experiment in the artificial growing of living tissues for an indefinite period.

No one who has had the privilege of witnessing Carrel's wonderful experiments at the Rockefeller Institute can possibly doubt the pernicious influence of toxins upon growth and activity.

Symposium on Intestinal Toxemia

In a symposium on the subject of intestinal toxemia, or "alimentary toxemia," the term used on that occasion, a discussion that occupied several sessions of the Royal Society of Medicine of Great Britain a few years ago, some sixty of the leading physicians of Great Britain presented at length the various phases of this important question. As the best means of giving the reader a correct idea of the present concensus of authoritative medical opinion on this subject we here present a concise summary of the views expressed by the leading speakers in this exhaustive discussion in regard to the poisons produced in the intestine and their effects upon the human body.

W. E. Dixon, Professor of Materia Medica and Pharmacology, King's College, London, enumerated the poisons that are produced in the intestine, chiefly in the colon.

Intestinal Toxins

"Amino-acids resulting from digestion are non-poisonous, but changes produced in them by putrefactive bacteria produce highly poisonous substances."

Lecithin and phosphorated fat found in the yolk of eggs is decomposed by the bacteria of the colon into cholin and other poisons.

Ammonia, always present with putrefaction,

produces disease of the liver. In experiments upon animals ammonia caused degeneration and hardening of the liver.

Many of the products of digestion are converted into poisons by putrefactive bacteria.

Tyrosine (an amino-acid, a product of digestion) is converted into tyramine, a highly poisonous substance.

Tryptophane and arginine (amino-acids) are converted into poisons, indol and skatol.

Sepsin, a poison so virulent that a minute dose administered to a large dog caused death in a few hours, is found in putrid meat and is always found in the colons of meat eaters.

Barger and Walpole demonstrated two pressure raising poisons produced from sepsin by putrefaction.

Tyramine is found in old cheese, in which it is produced by bacterial action. It is also produced in the colon.

Pressure Raising Poisons Cause Hardening of the Arteries

"In recent years it has been shown by different workers in our Cambridge Laboratory that any drug that has the power of considerably raising blood-pressure will, when injected into the circulation of healthy animals, bring about degeneration of the middle coat of the arteries. Generally about six injections must be administered before any changes are observed, and the effects occur alike in young and middle-aged animals. It has been shown that digitalis, squill, apocynum, barium, lead, ad-

renalin, nicotine, and even the inhalation of tobacco smoke, will all bring about these changes."

Poisons that cause rise of blood-pressure are produced in the intestine. Bain found these poisons present in the blood of persons who have high blood-pressure, showing that they are retained in the body instead of being destroyed or eliminated.

"Experiments have shown that a vegetable diet reduces the amount of these poisons in the urine."

Intestinal Toxins Cause Bright's Disease

These intestinal poisons have been shown by experiment to be capable of producing nephritis when absorbed from the mucous membrane as well as when injected.

Harvey has noted typical arteriosclerotic changes in the vessels from administering parahydroxyl-phenyl-ethylamine to rabbits, whether by mouth or intravenously.

In many of these experiments the heart was found enlarged and exhibited fatty degeneration.

In Harvey's experiments the most remarkable changes were found in the kidneys, and these were present both in the experiments in which the drug was injected, and in those in which it was administered orally. The change consisted in a chronic nephritis, showing many similarities to the large white kidney of man. He regards the changes in the kidney as secondary to a vascular sclerosis.

Ledingham, bacteriologist to the Lister In-

stitute, called attention to the fact that Bertrand, Dratschinski and others have shown by experiments on rabbits, guinea pigs and monkeys that phenylsulphate, indol, and paracresol, when given in small doses daily, produce marked changes in the blood-vessels in from one to four months. Changes are also noted in the liver and kidneys.

Influence of Diet on Intestinal Flora

Carrots may be advantageously used in a regimen that has for its purpose the changing of the intestinal flora. Bertrand found that when rabbits were fed on potatoes the urine contained indican, while the urine was free from indican when the animals were fed on carrots. The colon bacilli were more numerous in the colons of potato-fed rabbits. Bertrand thought that the greater amount of putrefaction in the potato-fed rabbits was due to the fact that there was less acid fermentation because less sugar was present. It was also noted that starch digesting bacteria were present in smaller quantities in the stools of potato-fed rabbits.

This experiment shows the value of raw starch as found in green vegetables in reforming the intestinal flora.

Stasis Causes Toxemia and Gall Stones

Mantle, Consulting Physician to Halifax Royal Infirmary, agreed with Sir Bertrand Dawson in the belief that colitis, as well as gastritis and catarrh of the duodenum, may be due to

infection from the vermiform appendix, and that catarrhal inflammation of the appendix and the colon may be carried upward to the stomach and duodenum. The gall-bladder may be infected from either direction. The most common origin of intestinal toxemia is catarrhal inflammation of the colon due to chronic constipation. That many people seem to be well, even though they suffer from constipation, is due to the fact that the natural defenses of the body are in their cases not yet broken down. Toxins do not readily find their way into the circulation until after the mucous membrane becomes abraded, or ulcerated, as the result of chronic infection.

Fatigue Poisons Produced in the Intestines

Sir Lauder Brunton said, "The *Bacillus coli* seems to have a special power of producing fatigue toxins, and many people in whose intestines it exists in great abundance suffer from constant weariness and a feeling of fatigue."

Joint Symptoms Due to Intestinal Toxemia

"Rheumatoid arthritis and other joint symptoms may arise from poisons absorbed from the intestinal mucous membrane. The joints are especially susceptible to certain poisons." (Mantle).

Intestinal Poisons and High Blood-Pressure

Said Dr. Langdon Brown, Physician to St. Bartholomew's Hospital, "The diamines, discovered by Barger and Dale to arise from the

decomposition of histidine, another product of protein breakdown, afford another promising field of study. There is a very wide-spread belief that alimentary toxemia is an important cause of the rise of blood-pressure in later life, and here we have an example of the production of definite pressor substances by intestinal putrefaction. But note that here, too, there is an abnormal intestinal microbe at work, the *Bacillus aminophilus intestinalis,* which supports my general contention.

"The poisonous substances formed in the intestine do not give rise to antibodies, as do certain other poisonous substances. These simple chemical substances, indol, phenol, etc., are neutralized by substances found in the body, protein sulphates, glycuronic acid, bile acids, glycogen, etc. The only way to secure immunity is to create a normal intestinal flora.

"Intestinal toxemia can not be combated by vaccines for the reason that the organisms that produce the poisons are outside of the tissues and hence can not be reached by the antigens."

Dr. Beezly Thorne, Kt. of Grace, Order of St. John of Jerusalem, said, "There are few phases of cardio-vascular trouble with which disorder of some part of the alimentary tract is not causatively associated.

"The great majority of such affections are associated with an alimentary toxemia which presents certain easily recognizable features.

"Shortly before he retired from practice at Plombieres, Dr. Bottentuit informed me that practically all subjects of long-standing colitis

presented myocardial weakness, generally with dilatation."

"A. E. Garrod argues that the transient joint manifestations accompanying erythemas, purpura, and urticaria are, like the cutaneous changes, toxic.

"Reference may be made here to the possibility that changes in the suprarenals due to alimentary toxemia may be instrumental in the production of arteriosclerosis. It has long been an article of faith that continued indiscretions in diet and over-eating cause chronic arterial and renal disease; more recently it has been noted that the suprarenals are large in granular kidney and arteriosclerosis, and it might again be suggested that indol and other bodies absorbed from the intestine cause hypertrophy of the suprarenal medulla (with increased secretion of adrenalin) and so high blood-pressure, and ultimately arteriosclerosis and granular kidney."

Arteriosclerosis Caused by Intestinal Poisons

Dr. E. Mellanby, Lecturer on Physiology, King's College for Women, stated that "Metchnikoff, Herter and others have shown that indol and skatol produced by the colon bacillus cause atheroma or degeneration of the blood-vessels, especially of the large aorta near the heart. Unquestionably these substances are highly toxic, as the effects observed by Metchnikoff were produced by very small doses of indol given daily during a few months." Yet, Dr. Mellanby states, "The indol derivatives are all

relatively innocuous compared with other substances found in the alimentary canal."

Dr. Mellanby mentions especially the powerful poisons, para-hydroxyphenylethylamine—the amine of tyrosine, iso-amylamine—the amine of leucine, and beta-imidazolethylamine—the amine of histidine.

"These are all very potent stimulants of plain muscle, and whereas parahydroxyl and iso-amyl raise the general blood-pressure, beta-i. has a marked depressant action on the blood-pressure. That para-hydroxyphenylethylamine and iso-amylamine may be responsible for chronic symptoms of intestinal toxemia, such as arteriosclerosis, seems to have been proved by the work of Harvey, who produced marked arteriosclerosis and a renal condition resembling the large white kidney by giving small quantities of these substances by mouth to animals over prolonged periods."

"The fact that Barger and Dale isolated beta-imidazolethylamine from the intestinal mucous membrane of normal oxen supports the view that the baccillus which produces this poison is a normal inhabitant of the intestine. Its distribution is affected by the diet to some extent, for a cat that has lived on an exclusive meat diet has the bacillus higher up towards the duodenum than a cat on a milk diet."

"Since beta-imidazolethylamine is present in the normal alimentary mucous membrane, the question arises as to why it lies in an apparently innocuous state without the production of symptoms."

"It is clear that if beta-i. is normally present in the alimentary canal, and if even when large quantities are present no general symptoms of poisoning are produced, then clearly it can only mean that when acute intestinal symptoms are produced they are due to the breaking down of the defensive mechanism of the intestinal mucous membrane which prevents the entry of beta-i. into the blood-stream."

"Beta-i. is never produced in the presence of carbohydrates and acids."

Dr. Alfred C. Jordan, an eminent roentgenologist, said, "In many subjects of intestinal stasis I find marked radiographic evidence of atheroma of the aorta at an unusually early age —another instance of the havoc wrought on the tissues by intestinal poisons."

Intestinal Bacteria Which Cause Diarrhea

Dr. Ralph Vincent stated that "the *Bacillus subtilis,* the *Bacillus mesentericus* and the *Bacillus mesentericus vulgatus,* growing in the intestine produce powerful alkaloidal poisons and are responsible for the most fatal type of 'summer diarrhea' in infants."

Intestinal Toxemia and Insanity

Dr. J. F. Briscoe, in discussing the subject from the standpoint of the specialist in mental diseases, remarked, "Who has not seen a prodigious evacuation of the bowels at the hands of the physician terminate a case of insanity, and, on the other hand, has not observed the skill of

the surgeon unfold the mechanical obstruction that has led to the deadly consequences of intestinal putrefaction."

"It is obvious that constipation is only a link in the series of causes and consequences arising from the disturbed abdominal viscera, and on the mental side encourages and accentuates such symptoms as apathy, irritability, perverted moral feelings, melancholia, mania—nay, suicide; while on the bodily side it produces very marked emaciation, rheumatism, cachexia, and a long string of diseases."

Said Dr. Lennox Wainwright, Hon. Physician to St. Michael's Medical Aid, and Physician to the Society for the Prevention of Cruelty to Children, "I am quite sure of this, that the mental effect on many patients of prolonged intestinal toxemia is such as to make them almost demented, and I believe that if many of our asylums were invaded by a good, sound clinical physician who would approach the subject without any preconceived idea, in many cases supposed to be hopeless, the melancholia and hypochondria would yield to comon-sense treatment and reduce the number of insane people."

The Tongue an Index to the State of the Colon

"The toilette of the digestive system has always been a difficult problem of solution. The state of the tongue may be a good index of intestinal health, and a foul condition of the breath speaks volumes of what may be suspected lower down, although the patient may not be constipated."

The constipation in such cases is latent and the barium test meal shows ileac stasis of a most pronounced degree.

The Cause of Arthritis and Gout

Said Dr. H. Douglas Wilson, "Diseases of the locomotor system not uncommonly find their origin in chronic intestinal auto-intoxication. It is a more than probable cause in some cases of rheumatoid arthritis, and of prime importance in gout, especially of the acute type. In quite a number of cases I have seen efficient lavage of the colon cut short an attack of this disease where previously all the more usual methods of treatment had failed to bring or maintain relief."

"Fibrositis, too, may find its origin in absorption of toxins from the digestive apparatus, and this is now recognized by many authorities as a direct cause of this painful and troublesome affection."

Toxic Effects Due to Eggs

Dr. H. D. Rolleston remarked, "Doctor Vaughan Harley suggests that the idiosyncrasy of some persons to eggs, which is now commonly quoted as an example of anaphylaxis, is due to the cleavage of lecithin into cholin, which may eventually yield the poisonous body neurin. In this connection I may mention that a medical man with neurasthenic symptoms and a belief during the morning that he was ruined, recovered after he left off taking an egg for breakfast."

Tetany, Rheumatoid Arthritis and Myxedema Caused by Intestinal Toxemia

Said Dr. Frederick Langmead, "On very good grounds, tetany is thought by many to be produced by toxins generated in the alimentary canal."

"In rheumatoid arthritis, we have a condition probably in many cases due to alimentary intoxication; in this condition overgrowth of the thyroid is apt to occur, and tetany, a symptom of ineffective functioning of the thyroid gland, is also found. Moreover, rheumatoid arthritis is occasionally distinctly benefited by the administration of thyroid extract."

"The last three cases of myxedema that I have had under observation have all shown, together with severe oral sepsis and very offensive motions, anemia of the pernicious form that Dr. William Hunter has for so many years ascribed to lesions in the alimentary tract. If the thyroid undergoes enlargement to combat undue toxemia, it is reasonable to suppose that relieving it of part of its burden may cause a simple goiter to shrink; this, of course, cannot be expected if adenomata or cysts are present."

The Colon Not a Superfluous Organ

Said Prof. Arthur Keith, Hunterian Professor, Royal College of Surgeons of England, the eminent English anatomist, "The researches of Sherrington, Hill, Mackenzie, Elliott and many others show us how closely the tone and contraction of the abdominal parietes are related to the pos-

ture of the body and to the condition of the viscera. We have not yet solved the problem of how the tone and contraction of the musculature of the body wall and the alimentary canal are co-ordinated, but we have sufficient evidence to lead us to suspect they are regulated by a common mechanism. It is probable that this mechanism may be acted on and deranged by pathological products generated in the intestine and that visceroptosis is one of the manifestations of alimentary toxemia.

"To anatomists who knew that the great intestine was an intrinsic part of every air breathing vertebrate, that it reached a high degree of development and specialization in every mammal that included a vegetable element in its diet, that in all the animals immediately allied to man—his contemporaries and his very ancient predecessors, the great intestine was shaped, arranged and developed as in him, the conclusion that the human great bowel was a useless structure seemed a flat contradiction of every law applicable to the animal body. It is hard to believe that a great structure that has served that long chain of ancestors, carrying man's lineage through the secondary and tertiary periods of the earth's formation and assisting man to become the dominant and universal species of the world, should suddenly fail him. We seem drawn to the conclusion that it is not the organization of the great intestine that has failed, but that our modern dietary sets a task for which it is not adapted. In civilized modern communities the great bowel has to manipulate a dietary such as was never before prescribed to it at any stage of

its long evolutionary history. If an engine runs unsatisfactorily it may not be from a fault in its mechanism, but from a defect in the fuel. Those who regard the great bowel as a useless structure blame the engine; for my part I stand by those who blame the fuel."

Toxemia Due to High Protein Diet

Dr. Murray Leslie, Senior Physician to the Prince of Wales's Hospital, said, "I was particularly interested in Mr. Rowell's reference to cases of intestinal stasis associated with thyroid enlargement, and in which the gland diminished in size on removal of the stasis, in one case as the result of administration of liquid paraffin.

"I have at present under my care an interesting case of Henoch's purpura in a boy, aged sixteen, in which the purpuric eruption, the abdominal pain and vomiting, the epistaxia and the albuminuria were all preceded by marked constipation, the patient stating that there had been no action of the bowels for seven days.

"I believe strongly in the importance of diminishing the intake of animal proteins, and there is a great deal of truth in Professor Keith's contention that the colon is more of a misused than a useless structure, owing to the extraordinary change that has taken place in the diet of man in civilized countries. I agree with Metchnikoff in thinking that the simpler food of uncivilized races may be best, and that it would be true progress to abandon much of the modern cuisine and to go back to the simple dishes of our forefathers.

"It is the excessive cleavage of animal proteins that is so harmful. In my experience intestinal stasis is much commoner in private than in hospital practice, and I attribute this fact to injudicious diet on the part of the better classes. The substitution of a two-meal diet for the three-meal diet of today would be a great advantage.

"While speaking of the effects of civilization I might add that, although we are erect beings, we are not intended by Nature to keep in the erect attitude (as we usually do, either sitting upright or standing) for eighteen out of the twenty-four hours. Our ancestors probably spent a good part of the day lying down, and great relief is experienced by patients with stasis adopting the recumbent attitude even for an hour or two every day and with the foot of the bed raised at night."

Toxemia the Cause of Hepatism

Mr. Mummery, Surgeon to St. Mark's Hospital referred to intestinal toxemia the symptoms resulting when the function of the liver fails—hepatism,—as also the symptoms of uremia which occur when the kidneys have become inefficient. He remarked:

"Some of the most interesting and important cases of auto-toxemia are those in which there are associated joint lesions of the nature of semi-acute or chronic arthritis. I believe that many of the cases of crippling arthritis that we see from time to time are due to poisons formed in the large bowel. I have seen several cases in which arthritis, both of the chronic and semi-acute variety, was associated with stasis and toxemia."

Sir Bertrand Dawson, M. D., Physician in Ordinary to H. M. the King, Physician to the London Hospital, and one of the leading physicians of Great Britain said, "Although the terms 'alimentary toxemia' and 'intestinal stasis' are open to criticism, they convey to our minds a definite clinical picture. The sallow, dirty complexion, the inelastic skin, the dusky lips and nails, the dirty tongue, evil-smelling breath, constant abdominal discomfort of one kind and another, the doughy inelastic abdomen, cold extremities, the physical and mental depression, are among the prominent features. That such a condition may be produced by colon block and stasis, is, I think, clear."

Protective Function of the Ileocecal Sphincter

Dr. A. F. Hertz, Physician of Nervous Diseases to Guy's Hospital, gave as the classical symptoms of intestinal toxemia, "extreme emaciation, extensive pigmentation, evil-smelling sweat, and cold extremities. . .

"The function of the ileocecal sphincter is to prevent the passage of the contents of the ileum into the cecum until sufficient time has elapsed for digestion and absorption of foodstuffs to be complete, as the chyme which reaches the cecum contains only traces of nutrient material in solution.

"Iliac stasis is thus a normal physiological condition of the utmost importance for adequate digestion.

"The ileocecal sphincter begins to relax at infrequent intervals some time after the arrival of chyme in the end of the ileum, but only when

another meal is taken does peristalsis occur at all actively in the extreme end of the ileum in addition to segmentation; the sphincter apparently relaxes as each peristaltic wave reaches it, a part of the contents of the end of the ileum being rapidly squirted into the cecum." In addition to the ileocecal sphincter the ileocolic junction is provided with a remarkable mechanical structure, the ileocecal valve which operates as an efficient check valve preventing the reflux of matters which have once passed from the small intestine into the colon. Profound intestinal toxemia probably does not occur (Schmidt) so long as the ileocecal valve is intact because the mucous membrane of the colon is a very efficient filter and absorption from the colon is very slow. The reverse is true of the small intestine.

The Symptom Complex of Intestinal Toxemia

Arbuthnot Lane, the eminent surgeon of Guy's Hospital, attributes to intestinal toxemia inflammation of the bile ducts and of the gall-bladder, gall-stones, inflammation of the pancreas, duodenal spasm of the pylorus, cirrhosis of the liver and Bright's disease.

Lane even goes so far as to say that "the gynecologists may also be regarded as a product of intestinal stasis." He enumerates the following conditions as due to intestinal toxemia:

"Wrinkles, atrophy of the skin, pigmentation of the skin, browning of the eyelids, also the skin about the eyes, the axillae, the abdomen, cyanosis, coldness of the hands and feet, sweating of the hands and feet, livid skin, roughness and dry-

ness of the skin, wasting of the muscles, general muscular weakness, curvature of the spine, wasting of the abdominal muscles, prolapse of the viscera, weakness of the heart, degeneration of the aorta, dilated heart, melancholia, imbecility, headache, symptoms resembling brain tumor, epilepsy, diseased conditions of the mammary gland—a nodulated condition, induration, cystic degeneration and later cancer—goiter, adenoids, enlarged tonsils—the result of lowered vital resistance, pyorrhea, endometritis, uterine cancer, various disease of the eye and baldness. In certain persons increased growth of the fine hairs covering the general surface of the body, tuberculosis, rheumatoid arthritis, Still's disease."

Skin Diseases Due to Intestinal Toxemia

Dr. H. G. Adamson, Physician in Charge of Skin Department to St. Bartholomew's Hospital, stated, "There are many skin eruptions—psoriasis, lichen, planus, pemphigus, scleroderma, pityriasis rosea, alopecia areata, lupus erythematosus and others—which are certainly definite entities, and almost obviously due to some specific cause, of the nature of which, however, we are as yet ignorant. There are circumstances which rendered it very improbable that these eruptions are due to the local presence of micro-organisms, and the only alternative seems to be to regard them as due to toxins. The most likely source of such toxins seemed to be the alimentary canal.

"One thing that has been learned from the experimental work in regard to the erythemas

and urticarias due to food poisons and drug poisons was the infinitesimal amount of poison which might suffice to cause an eruption; and it seemed probable that if these eruptions were due to toxins, they were toxins that were too small in quantity to be measurable by ordinary chemical methods."

Said Dr. W. Knowsley Sigley, "A too generous diet often plays an important part in some cases, especially in eczema, acne and psoriasis, and a change to a more or less vegetarian one will often bring about a cure. In some patients a diet of rice and water, in others a pure milk diet, will often clear up an old-standing and very obstinate skin lesion, especially if of an inflammatory or irritable type.

"The treatment of a large number of general skin eruptions resolves itself into the scientific treatment of chronic constipation.

"It is not the frequency of evacuation that is of importance but the quantity, that is to say, that the contents of the large bowel are systematically completely removed, and that there is not an ever-increasing residue left behind. In other words, it is necessary to be sure that the patient is not passing today what he ought to have got rid of a week, or perhaps a month ago."

Dr. James Galloway, Senior Physician of Charing Cross Hospital, holds that intestinal toxemia is capable of producing nearly all forms of skin disease. Among others, lupus, erythematosis and dilatation of the vessels of the skin, also purpura and pigmentation of the skin and

especially the following: A yellow tint due to urobilin, jaundice noted in cases of anemia, hemachromatosis, in which the skin acquires a mahogany brown or slate black color, a red brown tint noted in anemia, cirrhosis of the liver and enlargement of the spleen, and other pigmentation produced by methemoglobinemia and sulphoglobinemia.

Intestinal Origin of Certain Eye Diseases

Mr. Ernest Clarke stated: "Although not generally recognized, the eye, as a matter of fact, is an organ that registers in a very delicate manner certain conditions of the system, and amongst these conditions intestinal toxemia is markedly one.

"In quite early youth the crystalline lens is practically a small bag of semifluid jelly, and accommodation takes place by its being squeezed by the action of the ciliary muscle in such a manner that its anteroposterior diameter is enlarged. So great is the squeezability (if I may use the term) of the lens in the very young, that an accommodation power of 20 D. can often be recorded. As age advances a hardening process, or sclerosis, goes on in the lens as in all the other tissues of the body, and so its elasticity becomes less and less, until a point is reached when the near point of accommodation which represents the fullest accommodative power has so far receded that the normal eye requires assistance in the shape of a convex lens in order to see near objects distinctly. This hardening of the lens may be delayed by the absence of,

and accelerated by the presence of, certain poisons in the system, and intestinal toxemia takes a very high place in the list.

"One individual has only an accommodative power of 2.5 D., while another has 8.5 D. What is the difference between these two individuals? In the one aged forty with only 2.5 D. accommodative power the lens has hardened prematurely and become equal to the lens of a man aged fifty-five. That is, he is suffering from premature senility, and in the great majority of cases, in physical appearance, habits and powers he is aged fifty-five. There are many causes which help towards this premature senility, but the factor common to a very large majority of them is intestinal stasis. On the other hand, those whose accommodative power is higher than normal look much younger than their years, and are in every way younger, and on going into their history it will be found invariably that they have taken the greatest care to avoid the least suspicion of intestinal stasis.

"These facts, in connection with the premature senility of the lens, are another proof of the correctness of the old saying that 'a man is as old as his arteries;' the premature sclerosing of the vessels often taking place at the same time as the process in the lens.

"I think I have said enough to prove that premature hardening of the lens is a very constant sequela of intestinal stasis, and this is a very useful and easily ascertained index."

Old Eyes Made Young by Change of Flora

Here are three cases which have come under the writer's observation and which fully confirm the above observations by Prof. Clarke:

A young woman of eighteen years found her sight failing. Examination by an eye specialist showed that the young woman's eye accommodation was so much impaired that she needed glasses such as are usually worn by a person of fifty years. By a change of regimen and improvement of bowel action as recommended in this work the abnormality in a few weeks disappeared.

A college professor of fifty years, wearing glasses adapted to a presbyopic person of his age, after following for a few months the regimen recommended in these pages found his eyes improved to such a degree that he had the same range of accommodation as a normal person of fifty years.

A physician sixty years of age who had adopted a laxative, aseptic regimen found his glasses uncomfortable, and on examination by an oculist discovered that his glasses which he had been wearing for several years were ten years too old for him. A change was made to "younger" glasses, and he is still wearing them at the age of sixty-six, with entire comfort although they are adapted to a person of fifty.

In the above cases the rejuvenation of the eyes was accompanied by the disappearance of numerous symptoms of senility, and a great increase in physical and mental vigor and endurance.

The Effects of Intestinal Poisons

Changes in the arteries of the brain have been produced in monkeys to which small doses of paracresol have been administered daily during several months.

Experiments conducted by Metchnikoff and his students showed that hardening of the arteries may be produced in guinea pigs and rabbits by giving the animals daily small doses of indol and phenol.

Bouchard showed that an extract prepared from feces possessed highly toxic effects. He also noted that the feces of a person living on a mixed diet are twice as toxic as those of a person living on a non-flesh diet.

Herter showed that an extract of the feces of a carnivorous animal produces deadly effects when injected into the bodies of small animals while similar extracts of the feces of herbivorous animals do not.

W. J. MacNeal showed that cultures of Welch's bacillus, one of the most common organisms found in stools that have a foul odor, cause the death of guinea pigs in a few minutes when injected beneath the skin.

Why does the Intestinal Flora Require Changing?

Tissier observed in the study of the stools of infants that as soon as the weaning of the child began a sudden change in the flora occurred. The same was true when the infant was placed upon the bottle and fed cow's milk. The stools showed instead of the light lemon yellow color of health a darker color. The odor, no longer slightly acid

or neutral, became strongly offensive, putrid or ammoniacal. At the same time the child's breath often became offensive.

The stools show, in place of a nearly pure culture of acid-forming bacteria, various sorts of putrefactive organisms. As the child advances in age and its diet becomes more varied, especially when meat is added to its diet, the number and variety of the putrefactive organisms increase. The consequence is that by the time the individual reaches adult age the colon has come to be a veritable incubator of virulent putrefactive organisms that carry on within the body the very same processes that take place in the bodies of dead animals when left to themselves in a warm moist place.

In the words of Metchnikoff, "The micro-organisms inhabiting our bodies have set going there a poison factory which shortens our existence and by secreting poisons which penetrate all our tissues, injures our most precious organs, our arteries, brain, liver, and kidneys."

In a child brought up on a natural (vegetable) diet, according to Tissier, 90 per cent of all the bacteria in the intestine belong to the group of acid-formers, and the *B. bifidus* constitutes four-fifths of the acid-formers.

In children fed on a mixed diet the putrefactive bacteria develop and the proportion of acid-formers diminish.

Adolph Schmidt, one of the leading internists of Europe, thus describes the effects of intestinal toxemia:

"Most of the symptoms that clearly result

from the effects of intestinal decomposition are displayed by the nervous system. They are of the most varied kind. At one end of the series there is simple headache; at the other coma, convulsions and collapse. The more usual forms may be considered under the headings: (a) the general phenomena observed in cases of severe constipation; (b) epilepsy or eclampsia; and (c) psychoses. The general phenomena observed in cases of severe constipation include the nervous symptoms seen in chronic habitual constipation—feelings of being out of sorts, lassitude, headache, giddiness, neuralgia, ill-humor, and so on. Leube and others regard these as due to mechanical reflexes. Muller and Nothnagel believe them to be signs of neuropathic diathesis, aggravated by digestive disturbance. The adherents of the auto-intoxication doctrine (Bouchard, Senator, Albu) attribute them to increased intestinal decomposition."

The Most Common Putrefactive Colon Bacteria

The three putrefactive bacteria that are chiefly responsible for putrefaction in the human intestine are the *B. putrificus, B. sporogenes,* and *B. perfringens,* the *Bacillus of Welch.*

These bacteria are not only putrefactive but are pathogenic.

According to Burnet, "*B. putrificus* has been found in peritoneal suppuration, in appendicitis and in various intestinal disorders. *B. sporogenes* has been found in many cases of diarrhea. *B. perfringens* (*Bacillus of Welch*) is found in acute and chronic suppurations and infantile diarrhea.

It is also the cause of crepitating gangrene or gaseous phlegmon. The study of their virulence and toxicity by experiments on laboratory animals and monkeys has hardly been begun."

The *Bacillus of Welch, B. sporogenes, Staphylococcus pyogenes* and *proteus* all produce indol.

The *B. coli* does not attack proteins, but it induces putrefaction in peptones, giving rise to phenol, mercaptan and sulphureted hydrogen.

According to Ostertag, *proteus vulgaris* is the most important of the bacteria which cause putrefaction.

Burnet tells us that the intestinal flora of man (on a mixed diet) is practically identical with that of the dog. Even the alligator presents a smaller number of bacteria in his intestine than does man. The feces of man is like that of the dog only when his diet is like that of the dog.

Falloise found that the toxicity of feces diminish in the incubator. This is due to the fact that true putrefaction does not begin before the third day, when the reaction becomes alkaline. It is evident that in alkaline stools the putrefaction process must be very active and far advanced.

Roger enumerates more than 160 micro-organisms that have been found in the alimentary canal, more than one-third of which are known to produce active poisons.

According to Strassburger and other authorities the number of bacteria produced in the intestinal tract every twenty-four hours is so great that in many instances these organisms constitute one-half of the total mass of the solid contents of the feces. Many of these bacteria produce highly

virulent poisons. Not infrequently nearly the total mass of micro-organisms consists of poison-forming organisms, such as the *Bacillus of Welch* and other putrefactive organisms.

The colon bacillus, as pointed out by Metchnikoff, is an active poison producer under the conditions that are always present in the colons of persons suffering from intestinal toxemia. It is true that the colon bacillus is an acid-forming organism, as pointed out by Bienstock, but it has been clearly shown by Metchnikoff and his followers that this is true only when the organism is well supplied with carbohydrates. These are present if at all only in minute quantities in the feces of persons suffering from intestinal toxemia.

Foul-smelling stools always show a flora chiefly made up of anaerobes, or poison-forming organisms. It is true, as shown by Strassburger, that most of the microbes are dead. Some authorities estimate that not more than one per cent of the total number are viable, so that cultures made from the feces give no adequate idea of the number of bacteria actually present nor the amount of toxins produced by them.

Endo-toxins

It is doubtless true, as pointed out by Distaso and others, that the chief sources of toxins from which the body suffers are not the toxins that are set free during the life of the micro-organisms, but rather the endo-toxins that are liberated after the death of the organisms. The tremendous potency of these endo-toxins is well shown in the

reaction produced by the injection of a few drops of autovaccine, which consists simply of a heat-killed bacteria culture, and the toxines derived from a few million bacteria. When injected beneath the skin a vaccine often gives rise to very marked rigor followed by a high fever lasting several hours, with numerous pronounced systemic disturbances. It is evident that the quantity of these poisons derived from the small number of bacteria injected is many times less than that which we know to be daily produced in the human intestine. The chief reason that fatal effects do not ordinarily occur is to be found in the protection afforded by the intestinal mucous membrane and other organs of defense. The venom of a snake does no harm when brought in contact with the intact skin, but a very minute amount of venom introduced underneath the skin gives rise to distressing and often fatal consequences. So long as the mucous membrane of the intestine remains intact, it is able to filter out these poisonous substances. When, however, the mucous membrane is inflamed or eroded, this defense is broken down and the poisons gain access to the circulation. This fact explains many of the nervous and other distressing symptoms that accompany colitis, and also various anaphylactic phenomena associated with intestinal toxemia, among which may be mentioned urticaria and various other skin eruptions, asthma and migraine.

It is evident, then, that if the number of bacteria produced in the intestines each twenty-four hours can be materially lessened, distinct progress will be made in combating intestinal toxemia.

Changing and Reforming the Intestinal Flora

When Poehl, of St. Petersburg, more than thirty years ago, announced that the putrid stools of infants suffering from diarrhea could be made quickly to disappear by a buttermilk diet, the profession was incredulous; but within a few years the feeding of buttermilk to sick babies became almost a fad in Paris. This led to a bacteriological study of buttermilk. Grigoroff, working in the laboratory of Professor Massol in Geneva, discovered a vigorous growing acid-forming bacillus to which was later given the name *B. Bulgaricus.* Tissier, then first assistant to Metchnikoff, in studying this new organism found that it possessed to a remarkable degree the property of suppressing the growth of putrefactive organisms, a property which he showed to be common to all acid-forming organisms.

Metchnikoff soon announced this important discovery to the world and the new bacillus was hailed as a panacea for nearly all human ills. Buttermilk germs in tablets or vials were soon being dispensed by druggists and later by milk vendors throughout the civilized world, but the results were disappointing. Now and then good results appeared to follow the use of cultures, but on the whole the results fell very far below the expectations which had been raised. In discussing the question a dozen years ago, a distin-

guished French bacteriologist remarked, "Professor Metchnikoff eats a pound of meat and lets it rot in his colon and then drinks a pint of sour milk to disinfect it. I am not so foolish; I drink the buttermilk but omit the beefsteak."

To change the intestinal flora is not an easy matter. It is necessary to do something more than to simply introduce a few acid-forming bacteria. The soil must be changed. If we continue to put into the alimentary canal material of a sort that encourages the growth of putrefactive organisms, this class of micro-organisms will continue to be the dominant flora of the intestine. But even change of soil is not sufficient.

Several measures must be employed in conjunction to successfully change the intestinal flora. These are:

1. A diet that will produce in the intestine a media unfavorable for the growth of putrefactive and pathogenic organisms.

2. Increased activity of the colon.

3. The introduction into the intestine of large quantities of acid-forming or protective bacteria.

The intestinal flora may be favorably influenced by any one of these three measures, but for definite and rapid change of the flora, all three of the methods must be employed simultaneously. We will first consider each of the three distinct methods, and then the systematic combined method that produces the best and quickest results.

1. The Low Protein Diet

It is a matter of common observation that carbohydrates (starches and sugars) ferment, while proteins putrefy. Although both changes are due to bacterial action, there is a most important difference between the classes of microorganisms involved in the two processes. The organisms that give rise to fermentation produce simple acids—chiefly lactic or acetic acid—that are harmful only in very large quantities. In the minute quantity in which they can be produced in the intestine they are usually entirely harmless. On the other hand the microbes that give rise to putrefaction produce deadly poisons and toxins, a long list of which have been already mentioned, while there are doubtless many others not yet known. Bacteria, like other plants, require soils favorable for their development. It is evident that the most effective way of suppressing the growth of poison-forming, putrefaction-producing organisms in the intestine is to reduce to a minimum the amount of protein in the diet.

The marked difference in the character of the stools of a vegetable eating animal, like the sheep, and a carnivorous animal, like the dog, is clear evidence of the influence of a high protein diet in promoting putrefactive changes in the intestine. The same difference is observed between the stools of a flesh-eating man and those of a flesh abstainer. When meat and eggs are eaten freely, considerable of the proteins escape digestion and find their way into the colon, and

there undergo putrefactive changes. If, on the other hand, the diet is reduced to a minimum amount of protein, and the residues that reach the colon are small in quantity, the putrefactive changes are slight and the number of bacteria with their toxins and endo-toxins is notably lessened.

By a change of diet it is not only possible to change the bacterial inhabitants of the intestine, but to change the action, and even nature and influence of the colon bacillus and its congeners so that they no longer produce pernicious effects, but actually become a means of protection and defense. In other words, the wild bacteria that, in various ways, as already pointed out, find their way into the human intestine and give rise to putrefaction and other bacterial changes whereby poisons in large quantities are produced, may be changed. The researches of Kendall showed beyond question that these poison-forming bacteria cease to produce poisons when they are adequately supplied with carbohydrates of the kind that they can utilize.

Kendall found that even most virulent disease-producing bacteria, like the diphtheria bacillus, in the presence of sugar cease to produce toxins. The same is found to be true of the colon bacillus and various other bacteria that grow in the human intestine—with one or two comparatively unimportant exceptions.

How to get the required amount of carbohydrates into the colon is the problem. Sugar and cooked starch are so quickly digested and so completely absorbed in the small intestine that

it is by no means easy to get this element into the colon. Raw starch digests less quickly and milk sugar is more slowly absorbed than other sugars. Of course it is possible to inject carbohydrate into the colon by means of clysters.

Practically only two carbohydrates can be made to reach the colon without undergoing digestion and absorption—raw starch and milk sugar. Raw starch digests so slowly that when taken in more than very minute quantities a considerable portion will reach the colon and there be acted upon by amylolytic bacteria, which are always present; sugar is produced, supplying to the colon bacillus and other harmful bacteria the material necessary for changing the action of these organisms, so that they become protective instead of destructive through the harmless acids which they produce.

Sugar of milk in considerable quantities in connection with means for stimulating intestinal activity may also be made to reach the colon because of the great slowness with which it is digested and absorbed in adults. Milk sugar remains four times as long in the alimentary canal as does malt sugar. By means of the "milk regimen," which will be described later, it is possible to introduce lactose or milk sugar into the colon in almost any desired quantity.

When the colon is thus supplied with carbohydrates, fermentation takes the place of putrefaction and the acids produced not only prevent the development of poisons, but also act as normal stimulants to the colon, encouraging frequent and normal emptying of the colon.

To prevent misapprehension it should be here stated that the ordinary "milk diet," so called, is not an efficient method of introducing lactose into the colon, although it is probable that the increased quantity of lactose that finds its way into the colon in connection with the milk diet is one of the principal means of securing the beneficial results sometimes secured by milk feeding. We shall describe a practical method of using milk, the "milk regimen," by means of which surprisingly good results have been obtained.

Since the epoch-making experiments of Chittenden, supplemented by those of Folin, of Harvard, Hindhede, of Copenhagen, and other investigators, the sufficiency of a low protein diet to support life and health can no longer be questioned. Folin, in fact, states that ordinary foodstuffs contain a sufficient amount of protein to supply the needs of the body, so that a person taking a variety of fruits, grains and vegetables in his daily bill-of-fare need have no apprehension of injury because of the restriction of the amount of protein eaten, although flesh foods and even eggs may be excluded. Combe and many others have shown by many observations that by eliminating from the diet all foods rich in protein putrefactive processes may be controlled and the total number of bacteria produced in the intestine greatly lessened.

This fact has also been very clearly established by the experience of the writer and his colleagues of the Battle Creek Sanitarium, where for more than forty years a low protein dietary

has been employed as a prominent feature in the general therapeutic program employed in the treatment of more than one hundred thousand patients, all of whom have been subjected to a low protein dietary. The great benefit derived from the reduction of the amount of protein has in most cases been so pronounced that the patient, as well as the physician, has been thoroughly convinced of the value of the low protein regimen.

Results of Recent Experiments

The views prescribed above which have been held and advocated by the writer for some years and have been abundantly verified by clinical experience, are fully sustained by a remarkable experimental research conducted by Drs. Rettger and Hull, of Yale University, and reported in the *Jour. of Bact.* (1917) pp. 47-71.

These investigators showed that "lactose, milk, and mixed grains (wheat, oats, etc.) are specific articles of diet which exert an influence on the intestinal bacteria. Lactose, when fed in sufficient quantities (2 or 3 gm. daily), brings about a complete transformation of the flora of white rats within two or three days; milk requires a longer time, and does not bring about a complete change. Milk and lactose together form the most practical and effective diet, at least for man. Grain feeds tend to increase the number of aciduric bacteria, but their influence is comparatively small.

"Milk undoubtedly owes its beneficial action to the lactose, which constitutes almost half of the solid matter present. The explanation of

this action must lie in the fact that the lactose is absorbed slowly from the intestine. On several occasions it has been found in the feces of rats that had been supplied with it as a part of their diet. The raw grains are also probably acted upon slowly, or at least some of the intermediate carbohydrate products are not immediately absorbed. Bread, on the other hand, which contains cooked starch, does not foster the development of the aciduric bacteria, because it is digested quickly, and no available sugar remains in the intestine long enough to be attacked and utilized by this group of bacteria.

"Meat or other high protein diet increases the indol-producing bacteria and other organisms of the so-called 'putrefactive' type, like *B. coli* and *B. welchii.*

"The marked influence of a high lactose diet upon the intestinal flora of man, which was demonstrated in these experiments, has been confirmed by other investigators working with typhoid patients, who found that eating milk sugar (250 to 300 gm. daily) brought about a marked change in the intestinal flora where the initial flora has been of a distinctly putrefactive type. The authors state that in both the earlier and present work they were unable to establish *B. bulgaricus* in the intestine of white rats even for short periods of time, although the bacilli were fed in large numbers. These results are in harmony with those of other investigators."

The above observations show beyond room for doubt the importance of supplying to the colon the carbohydrate necessary for promoting

the growth of acid-forming bacteria. The only way in which this can be done is by proper regulation of the diet and increasing peristaltic activity. The regimen must supply forms of carbohydrate which will be slowly absorbed so that some of it may have a chance to reach the colon. Lactose, or milk sugar, is the most slowly absorbed of the sugars. It remains in the intestine four times as long as does dextrose, or maltose, that is the sugars formed in fruit juices and that formed by the digestion of starch. By feeding a portion of the starch in an imperfectly cooked condition, the desired end may be accomplished, since raw or partially cooked starch is digested very slowly and hence may reach the colon before absorption. It has been shown by Distaso and others as well as Rettger that some of the colon bacteria are amylolytic, that is, are able to convert starch into sugar, and so can supply to the colon bacilli and other organisms the sugar they need to change their action into acid-formers, so that they will cease to produce indol, skatol and other toxins, ptomains, ammonia and other poisons which are found in putrid stools.

In the fruit regimen, half a pound of milk sugar is given daily, the amount Rettger found necessary for producing the change of the colon flora. With the fruit regimen the colon is kept empty and a sufficient amount of starch and fruit sugar reaches the colon to produce the needed acid fermentation. It is often advantageous to add to the regimen four to six ounces daily of lactose or a mixture of lactose and maltose. In the after-diet, "brose," or half-

cooked cereals supplies the raw starch needed to feed the sugar-forming and acid-forming bacteria and so secure normal bowel action and arrest of putrefaction in the colon and of the chronic intestinal toxemia which results therefrom.

2. Increased Intestinal Activity

The multiplication of bacteria in the intestine is more actively encouraged by stasis or stagnation of the intestinal contents than by any other factor aside from an excessive amount of protein in the dietary. A most important means of lessening the multiplication of bacteria in the intestine is acceleration of the food materials along the intestinal tract. Delay of intestinal contents at any point along the twenty-seven feet of small and large intestine is quickly followed by the development of active bacterial changes. While active digestion is taking place, putrefaction and fermentation are restrained. When the several digestive cycles have been completed, fermentation or putrefaction becomes active—the nature of the process being determined by the dominant character of the food residues. If these are chiefly carbohydrates, fermentation results; if protein, putrefaction.

Normally the stomach becomes empty in about four hours after the beginning of a meal and the small intestine discharges the last remainders of the meal into the large intestine four hours later. In other words, the process of digesting and absorbing a meal normally occupies about eight hours. Three or four hours later the undi-

gested residues of foodstuffs, mixed with excretory substances derived from the liver and intestinal mucous membrane, in a perfectly normal person may be discharged from the body. Under such circumstances the opportunity for putrefactive changes is so slight that the bacteria developed are comparatively few, and the amount of poisons produced is exceedingly small. In carnivorous animals the time required for the transit of foodstuffs through the alimentary canal is much shorter. Results of experimental researches published by the United States government showed that the time that elapses between the taking of food and the discharge of the unused residues is in the barn yard fowl only three and one-half hours. In the fruit-eating bat of South America the time is only one hour. The alimentary tube of herbivorous animals is thirty times the length of the animal's body and the time of transit is necessarily considerably longer. Metchnikoff showed many years ago by extended researches that those animals live the longest that have the shortest colons. Some animals, such as the eagle, which live on an exclusively flesh diet, nevertheless live to great age because of the extreme shortness of the intestinal tube, which affords no opportunity for stasis and hence little chance for putrefactive changes.

The evident relation between intestinal stasis and resulting toxemia was the consideration which led Lane to devise the operation of short-circuiting, and the still more radical operation of excision of the colon. So far as these operations serve to hasten the discharge from the body of the undigested, unusable residues of foodstuffs,

putrescible mucus and other wastes, they may render essential service in the treatment of intestinal toxemia; but after several years of close observation and extensive experience in dealing with this class of patients the writer is convinced that in a very large proportion of the cases that have been subjected to these mutilating operations much simpler and wholly non-surgical measures may be employed with entire success. Lane's most recent recommendation is that paraffin oil should be tried as a means of securing increased bowel activity before resorting to surgical measures.

It must be clearly understood, however, that by increased frequency of bowel movement is meant, not simply one bowel movement a day, but at least three full bowel evacuations. In many cases it is desirable that as many as four evacuations should be secured. The normal rhythm of bowel movement is three evacuations daily, or a bowel movement after each meal. Briefly stated, my reasons for this belief are these:

In healthy infants the bowels usually move soon after feeding. The same is true of healthy animals and active healthy boys and girls who are fed upon a natural diet that is sufficiently bulky to produce normal peristalsis.

Among primitive people the bowels move after every meal. Three evacuations are generally the habit. This fact was ascertained by a questionnaire sent out to several hundred medical missionaries stationed among people of the most primitive types. Doctor Sheppard, an experienced practitioner of Aintab, Turkey, says,

"Among the Turks three bowel movements a day is the universal habit. When a Turk's bowels move less than three times a day he consults a physician." Dr. William Arbuthnot Lane told the writer that he was once consulted by a member of the Turkish Embassy in London for relief of constipation because his bowels moved only once a day, and he stated that he found his vital stamina was very greatly diminished when his bowels moved less than three times a day.

A Bushman said to a missionary doctor whom he consulted for relief, "Doctor, I am horribly constipated; my bowels move only once a day."

The chimpanzees and other big apes in zoological gardens move their bowels four to six times daily.

Hundreds of persons who have come under the writer's observation and have been induced to adopt the necessary measures for securing three bowel movements daily, have experienced notable improvement in health and the disappearance of headaches, languor, sleeplessness, loss of appetite, coated tongue, foul breath and a great variety of other symptoms that form the familiar clinical picture of intestinal toxemia.

Since the process of digestion and absorption is normally completed in eight hours no reason whatever can be assigned for the retention of the unusable remainders and waste matters that contribute nothing to the welfare of the body and may become a source of infinite mischief through putrefactive changes while waiting for delayed evacuation.

Food is the natural laxative. When food is

taken into the stomach peristaltic waves begin passing along the organ from above downward at the rate of three to five waves a minute. The peristaltic waves do not stop at the pylorus but continue along the whole length of the intestine, so that the taking of food stimulates the movements in the colon. According to the observations of Hertz, Case, and others, the contents of the colon are pushed forward four times as rapidly during the taking of a meal as when the stomach is empty.

The writer has met a number of unusually healthy persons who attributed their remarkable health and vigor at an advanced age to the fact that all their lives they had had the habit of moving the bowels three times a day.

It is usually quite easy by the methodical use of simple means to acquire the habit of three bowel movements daily and the results of this practice have always been found to be beneficial and in no way harmful. The method is quite simple. It is only necessary to supply the proper amount of bulk and lubrication required in each individual case. For giving to the diet a proper amount of bulk, Nature has provided only a single food substance. This is cellulose. Animal foods of all sorts are practically all completely digestible. Little or no residue is left in the digestion of meat for the reason that meat represents material that has once passed through the process of digestion in the digestive organs of an animal and hence is capable of undergoing complete digestion when exposed to the proper digestive juices. Cellulose is the one substance found in foodstuff that

is not digestible in the human alimentary canal, although in certain animals, particularly herbivorous animals, nature has made provision for the digestion of cellulose.

Cellulose is found in larger or smaller quantities in practically all vegetable foods. In some instances it is found in larger quantities than in others. The cellulose content of our foods varies greatly. In fruits and fresh vegetables cellulose is found in a newly formed state in which it is very easily broken up, and it is on this account less valuable as bulk-producing material. It is easily acted upon by bacteria and broken up into gases resembling illuminating gas. The bran of cereals represents an older form of cellulose in which it has been transformed into wood and which is resistant to bacteria. Agar-agar represents a peculiar form of cellulose known as "hemi-cellulose" which is soluble in boiling water. This also is indigestible. All forms of cellulose are useful in giving bulk to the intestinal contents; but bran and agar-agar, known also as "Japanese isinglass," are the most valuable of all.

For efficient stimulation of the intestine it is necessary to take with the food daily from two-thirds of an ounce to one or two ounces of cellulose. This indigestible material or roughage should not be taken at a single dose but should be taken at each meal in such a way that it will be thoroughly mixed with the various other food substances so that it will be equally distributed along the intestine. Care must be taken that the requisite amount of cellulose is taken at

every meal without exception. The omission to supply the necessary bulk for one single meal may give rise to stasis, the ill effects of which may last for several days.

Lubrication Necessary

In addition to increasing the bulk of the food, lubrication is often required. This may be secured by the use of paraffin in some form. The Russian paraffin oil renders the most valuable service in these cases. Examination of the bowels and rectum generally shows, in cases of chronic constipation, a dryness of the mucous membrane. By the use of paraffin oil, which is not a food, undergoes no change and acts merely as a mechanical lubricant, the mucous surface is so lubricated that the fecal matters do not adhere, but slip readily along, even when redundant development may have given rise to folds and kinks which are more or less obstructive, or when adhesions exist that offer mechanical obstacles to the progress of the alimentary residues along the colon. Half an ounce to an ounce of heavy white Russian oil should be taken just before each meal. There are some inconveniences that accompany the use of paraffin oil that may be overcome. The writer has found the use of paraffin with melting point at 102° F. most efficient. One or two tablets taken at each meal in connection with a proper amount of bulk-producing material rarely fails to secure normal movement of the bowels three times a day, or after each meal. By the application of the two measures above outlined, a

low protein diet and some simple means for accelerating the material along the alimentary canal, putrefactive processes in the intestine may be controlled to an enormous degree and the number of bacteria may be greatly reduced.

3. The Displacement of Harmful, Putrefactive Bacteria by Harmless Acid-Forming Organisms

According to Burnet, the idea of supplanting putrefactive bacteria present in intestinal toxemia by beneficent acid-formers originated with Quincke.

"To combat the intestinal putrefaction, it is necessary to adopt a diet capable of producing in us that limit of acidity which induces the crisis separating the two phases of putrefaction of meat or milk, and of arresting decomposition in our bodies at the end of the first phase. Therefore, we ought to eat carbohydrates and sugars, and so alter the conditions in our intestine as to favor the lactic ferments." (Burnet.)

In extensive experiments conducted under the supervision of the writer in the bacteriological laboratory of the Battle Creek Sanitarium it has been demonstrated that when boiled or even slightly cooked starch is present to the extent of two per cent the growth and activity of putrefactive organisms in feces are controlled. Acids are produced in place of ammonia and fermentation predominates over putrefaction.

The principal battle waged between beneficent and pernicious bacteria in the intestine, is, according to Burnet, between the *B. Welch* on the one hand and *B. bifidus* of Tissier on the other.

Those bacteria that produce the largest amount of acids are most active in resisting the growth of putrefactive organisms.

The *B. acidi paralactici,* the *B. bifidus,* and the *B. Bulgaricus* cease to grow only in stools containing five per cent of acid; while *B. of Welch* is inhibited by an acid solution of the strength of .16 per cent.

While on a visit to Europe several years ago (1907) the writer secured cultures of *B. Bulgaricus* from the Pasteur Institute. New cultures were speedily made in our laboratory under the supervision of our bacteriologist, Dr. A. W. Nelson. For the purpose of making a crucial test of the ability of the *B. Bulgaricus* to suppress putrefaction, a beefsteak was put into a culture of the bacillus. Although the flesh was slightly tainted, when examined, a few days later, it was found to be entirely free from taint. This experiment is still in progress. The beefsteak is absolutely free from any putrefactive change. Bacteriologic examination shows no putrefactive bacteria present. The flesh after ten years has the appearance of fresh meat made a little paler than usual by the long continued immersion to which it has been subjected.

This method of preserving meat was not discovered by the writer. It was generally practiced by the pioneer women of our western frontier, who often kept their fresh meat for several weeks by immersing it in pans of sour milk. I learned recently from a gentleman who has traveled extensively in the East that a similar practice is also in vogue among the Arabs,

who preserve their fresh meat in camel's milk.

The philosophy of this method is exceedingly simple. The *B. Bulgaricus* introduced with the food is expected to find its way into the colon and there by producing lactic acid to develop a condition unfavorable to the growth of putrefactive bacteria which cannot develop in an acid medium.

Two conditions are requisite for the success of this method.

(1). The *B. Bulgaricus* must reach the colon in sufficient numbers to be able to produce a sufficient amount of lactic acid to acidify the colon's contents.

(2). It is necessary that the *B. Bulgaricus* shall find in the colon the food necessary for its sustenance and by the aid of which alone it is able to produce lactic acid; viz., carbohydrate.

Unfortunately, both of these conditions are very difficult to secure. The *B. Bulgaricus* is likely to be destroyed by the digestive fluids on its way to the colon, while the sugar which is essential for its development is almost certain to be absorbed in the small intestine, so that the acid-forming bacilli speedily starve to death after reaching the colon for lack of suitable nourishment.

It is hardly to be expected that any considerable amount of benefit could be derived from the swallowing of two or three little tablets carrying a few millions more or less active specimens of the Bulgarian bacillus. When the bacilli are introduced in this way it is very rare indeed that they can be recovered from the

stools. It is necessary that large quantities of very active cultures should be taken, and special measures must be adopted to supply *B. Bulgaricus* in the colon with the carbohydrate which it requires for efficient growth.

One way of accomplishing this is by the administration of freshly prepared yogurt buttermilk in connection with the milk regimen. It may also be accomplished by administering fresh cultures of the *B. Bulgaricus* in massive quantities.

The *Bacillus Bulgaricus* is a vigorous organism and seems to have become widely dispersed. Different strains seem to differ somewhat in vigor and in the flavor of the product. In addition to the original culture obtained from Paris, several active strains have been collected and are used in combination.

Milk fermented by *B. Bulgaricus* has been largely used in Bulgaria and in adjacent countries from the most ancient times. One very active strain was received from a friend in Sophia, Bulgaria, a former patient who kindly sent us several samples with information concerning the native ways of preparing and using yoghourt.

Through the courtesy of a missionary recently returned from Mesopotamia we received a very active strain producing an unusually pleasant flavored buttermilk which was brought from Mt. Ararat. A native tradition maintains that this highly valued product was brought over from the antediluvian world in the ark of Noah.

Another very vigorous strain was sent to us by

a medical friend stationed at Darjeeling in the Himalaya Mountains, where it is used under the name of *dahi.*

Still another excellent ferment was sent us by Doctor Matthiasson, of Iceland, where it is used in the preparation of "skyr," a fermented milk preparation that is very largely used by the natives, especially for the correction of gastric and intestinal disorders (*Streptococcus lacticus.*)

Tissier and Distaso showed years ago that the *Bacillus Bulgaricus* does not establish itself in the human colon. It is for this reason that it is necessary to furnish a constant supply of this friendly germ in the form of buttermilk or otherwise. In the author's experience the Bulgarian germ is highly useful as an aid in changing the intestinal flora especially in cases of gastritis and colitis.

Other Anti-Toxic Ferments

The *B. Bulgaricus* is not the only protective ferment known to bacteriologists. All the lactic acid-producing ferments, of which there are many, may be regarded as more or less protective in character. Most of these, however, like the *B. Bulgaricus,* are not native to the human intestine, and to do service must be continuously supplied, since they cannot be made to grow permanently in the intestine without being reinforced by fresh cultures. Of very special interest, on this account, is the *B. Bifidus,* discovered by Tissier, which was shown by him to be a natural protective organism which is planted in the intestine soon after birth to pre-

vent the development of putrefactive and other harmful organisms. The *B. Bifidus* produces acetic acid, and grows naturally in the colon.

Still another protective organism that may be of some service is *B. glucobacter,* discovered by Wollmann, an assistant of Metchnikoff's. This organism has the property of converting starch into sugar. It thrives in the colon, where it may render essential service by supplying suitable food for the *B. Bulgaricus* and the *B. Bifidus.* The writer has found the best results from giving in very large quantities an active culture containing all three of these protective organisms. Such a culture given in quantities of a few ounces before each meal and in connection with a suitable dietary has produced most excellent results. To insure a rapid change of the intestinal flora it is necessary, in addition to the administration of cultures of acid-forming organisms, to put the patient upon a dietary that will introduce into the intestine a considerable amount of starch. It has been found experimentally that with such a dietary it is possible to introduce into the colon carbohydrates to the amount of ten or twelve per cent of the total solids of the feces. Four or five per cent is an ample quantity to secure results desired.

With reference to protective organisms, Burnet of the Pasteur Institute speaks as follows: "The artificial cultures chosen for their chemical properties are chiefly *B. bifidus, B. acidi paralactici,* and the lactic ferment that has become popular under the name of the "Bulgarian Bacillus." They are given either singly or in asso-

ciation, and in the form of clotted milk or in bouillon. The characteristics of the Bulgarian bacillus are briefly the following: it produces 25 grams of lactic acid per litre of milk; not more than 0.50 gram of succinic and acetic acid, traces of formic acid, no alcohol, and no acetone. It attacks the protein hardly at all, and has no pathogenic power (G. Bertrand and Weisweiler). Although it does not inhibit the development of the *B. coli* in a culture containing peptone, it at least prevents it from producing phenol, and greatly reduces its indol production.

"The mechanism of the action of the lactic ferments in general is not quite settled. They appear to diminish the number of anaerobes and of the *B. coli.* The diet of sour milk reduces the ethereal sulphate of the urine more than does a diet of sweet milk."

It is of interest in this connection that most savage or primitive people make use of sour milk. The savages of Central Africa make use of milk only after converting it into a sort of kumyss by leaving it for some hours in a gourd especially used for the purpose. A portion of the ferment is always left behind in the gourd, which is never washed, so that a high degree of acidity is developed in a few hours.

The half civilized Tartars of Western Asia prepare milk in the same manner, as do also the Turks and Armenians. The natives of Italy use milk from goats instead of that from cows, a custom that will be better appreciated when the fact is known that goats are not subject to that dread disease, tuberculosis, so common among

cows. Even the German peasant scalds the milk as soon as it comes from the cow, and makes little use of the article except in the sour state, in which it is comparatively safe. The Irish peasant is equally fond of sour milk, as also are the natives of Scandinavian countries.

Certain yeasts produce lactic and other acids and have been used with some success in combating intestinal putrefactions. These organisms produce great quantities of gas as well as alcohol and other objectionable substances, and hence cannot be recommended for practical use.

Still another highly useful protective organism is the *B. acidophilus.* This bacillus is native to the body and is present in the stools of healthy nursing infants but is later driven out or overgrown by the "wild" bacteria which are introduced in cow's milk, meat, stale eggs and other infected foodstuffs. The *B. Acidophilus* may be restored to the intestine by administering it in large quantities of active culture in connection with *B. Bulgaricus* and *B. bifidus.*

Preliminary Examination and Preparation of the Patient

It is highly important that the patient before beginning a special regimen should be subjected to a thoroughgoing physical examination, a careful study also being made of his metabolism. Without such an examination it is impossible to know whether or not the patient is in a condition to profit by the special regimen, or whether he may not even be injured by it. After the examination is completed, the patient should undergo a short course of preliminary treatment whereby he may be prepared to derive the greatest possible amount of benefit from the special regimen to which he is to be subjected for a more or less prolonged period.

The Examination

In addition to the usual history taking and subjective examination, in which symptoms, predispositions, etc., are carefully noted, a special investigation should be made of the patient's eliminative processes; the condition of the skin as regards color and texture should be observed, and in addition to the ordinary quantitative and qualitative examination of the urine, the renal efficiency should be tested and when possible a determination should be made of the amount of

non-protein nitrogen, uric acid, urea, creatinin, and sugar in the blood.

"It must be borne in mind that the amount of indican found in the urine is not a correct indicator of the amount absorbed from the intestine. An unknown quantity of indol and skatol may be lost by oxidation after absorption. Jaffa proved that when indol is swallowed, only about one-fourth can be recovered from the urine." (Schmidt.)

When indicated, a gastric test meal should be given, preferably the Ewald breakfast, and a thoroughgoing X-ray examination of the alimentary canal by means of the barium or bismuth meal is also highly desirable.

The motility of the alimentary tract should be determined by means of carmine (see page 123). note being made, not only of the time of the appearance of the color in the stool, but also of the time of its disappearance.

The examination of the chest should include an X-ray examination of the heart and lungs.

The differential blood count should be made, and the blood-pressure determined.

Careful examination of the teeth should be made by a competent dentist. If possible, an X-ray of the teeth should also be made.

In young people and in persons of middle age, it is desirable to have the eyes examined, especially with reference to the range of accommodation, which is often greatly limited in chronic intestinal toxemia.

The strength of the principal groups of muscles should be tested with the dynamometer.

The net weight of the body should be obtained and endurance tests are desirable when suitable testing apparatus is at hand. With the data thus obtained, coefficients of height, weight and height-strength, etc., may be worked out. These coefficients are of great value in regulating the nutrition of the patient.

In determining the weight, the patient should be weighed without clothing, or wrapped in a sheet the exact weight of which is known. When more convenient, the patient's weight may be taken with the clothing and the weight of the clothing determined afterwards. In general, it is best to obtain the weight in the morning before breakfast and before the patient has taken food or liquid into the stomach.

Examination of the Stools

A thorough examination of the stool should be made especially with reference to the dominant bacterial flora and the amount of ammonia present.

When a young infant is ill and a physician is called, the first inquiry is always in relation to the bowel discharges. The importance of examining the stools in the case of an infant is so generally understood that a doctor calling to see a sick infant usually finds that the mother or nurse has reserved a soiled napkin for his inspection. If the infant's stool has a yellow color, is of soft consistency and has no odor or a slightly acid odor, the physician is able to assure the mother there is probably no serious trouble with the little one's bowels; but if the

stool is dark in color and foul smelling the physician recognizes at once that the child is suffering from intestinal toxemia and that measures must be taken at once to get rid of the wild bacteria that have invaded the colon and to restore the normal flora.

The importance of studying the stools of young infants has been long recognized. With this fact in mind it is very surprising indeed that the stools of adults are seldom inspected by either the physician or the patient. The physician inquires, perhaps, whether the bowels are regular. If the patient replies, "Yes, my bowels move every day," no further inquiry is considered necessary. At least, this is usually the case. As a matter of fact, a thorough examination of the stools is just as important for adults as for infants. Neglect to make careful examination of the stools is probably the chief cause of the failure to recognize the important part played by putrefactive processes in the colon in the development of a great number of grave disorders. Every intelligent person should know the general characteristics of the normal stool, as it is by the observance of the stools that one may determine better than in any other way the condition of the intestinal tract. Fortunately, the points of greatest importance in judging the character of the stool may be noted without the aid of expert knowledge and laboratory appliances. The following is a brief account of the characteristics of the normal stool and of the changes that may be readily noted:

Mass

The amount of solids contained in the stools is very small on a diet of animal food—eggs and milk or meat—amounting to only half an ounce to an ounce (Spence). One-third of this consists, according to Strassburger, of bacteria. Such a diet is necessarily constipating. The weight of the bowel discharges for twenty-four hours is six to eight ounces for a person living on a mixed meat diet, and twelve, sixteen, or eighteen ounces for a person living on an exclusive vegetable diet. The weight of dried matter is about one-fourth the above figures, the normal stool being about three-fourths water. When the intestinal contents enter the colon from the small intestine the water content is nine-tenths the total volume, making the total amount about twenty to forty ounces, an average of one quart, from which it appears that the amount of fluid that is absorbed from the colon is scarcely more than a pint or a pint and one-half, which is only about one-tenth the amount which is absorbed in the small intestine. Most of the liquid absorbed in the colon is taken up in the cecum. Absorption is very slow in the distal half of the colon, an arrangement that is an important protection against the absorption of the poisonous products resulting from putrefaction.

With a coarse vegetable diet the bulk and weight of the stool may be twice as great as above mentioned.

Form

In some persons the fecal residues are greatly reduced in amount. This condition some authorities refer to as greedy colon and attribute to "too good digestion." This explanation can hardly be accepted. It is impossible for digestion to be too good. The amount of the fecal residue is reduced because of the presence in the intestine of bacteria that destroy the cellulose, the element that normally makes up the greater bulk of the feces. Cellulose is not acted upon by the digestive juices of human beings, though it is digested by herbivorous animals, which possess special digestive ferments for this purpose. Under the action of certain bacteria, some of which are associated with putrefactive processes, cellulose is converted into "marsh gas," one of the constituents of ordinary illuminating gas. These so-called cases of greedy colon are promptly relieved by proper means, particularly by the taking of paraffin oil in connection with a sufficient amount of bulk-producing material in the form of cellulose.

The normal form and consistency of the stool is that of soft mush. The so-called well formed stool is the result of constipation. When the food residues of a meal find their way to exit in twelve to sixteen hours they have the consistency of a thick puree. It is only when these waste materials have remained in the lower colon twenty-four or forty-eight hours or more that they become sufficiently dried to present the appearance of the well formed stool. When the colon contents are retained so long that a large

part of the water is absorbed, the stool appears in the form of oval balls, having something the shape and consistency, though larger in mass, of the droppings of sheep. These scybala are not broken fragments of a large mass. Each one is a mass of fecal matter that has been separately molded and laboriously pushed along through a contracted colon by successive series of peristaltic waves, the only possible means of progress. The accompanying cut shows the appearance of the colon as revealed by the x-ray when struggling to empty itself of such hardened masses. In the normal colon great mass movements occur, the colon emptying itself almost completely by a single movement executed so rapidly that it can scarcely be followed with the eye when observed by means of the x-ray.

When the feces appear as a soft foamy or frothy mass that floats upon the surface, the indcation is that active fermentation is taking place in the intestine, which is also usually indicated by a sour or rancid odor.

Color

The color of the stool naturally varies more or less with the food. An exclusive milk diet produces yellow stools, a diet consisting largely of meat produces black stools. With a mixed diet the stools are dark brown. An exclusive vegetable diet produces light brown, yellow, or orange stools. The use of highly colored vegetable foodstuffs, such as carrots, spinach, huckleberries, raspberries, etc., usually impart to the stool their characteristic color. A normal stool

consisting of vegetable foods, with milk or milk and eggs, should not differ much, either in color or consistency, from the stool of a nursing infant. It should be yellowish or orange in color and of soft consistency.

Odor

The normal stool has a slight fecal or faintly acid odor. Fermenting stools have a sour odor. Stools that contain a large amount of fermenting fat have a rancid odor. The dark-colored stools of meat eaters have a putrid or stinking odor, the result of putrefaction. When putrefaction is well advanced the stools have a strong ammoniacal odor. In very offensive stools, rancid, ammoniacal and putrid odors are often combined. A peculiar odor may be given to the stool by strongly flavored foods—asparagus, onions, eggs, etc. The odors usually noted in describing the characters of a stool are, normal, putrid, very putrid, acetic, butyric (rancid), ammoniacal, strong, musty.

Reaction

The reaction of a stool is determined by dropping upon its moist surface bits of red and blue litmus paper. If the blue paper is turned red the stool is acid. If the red paper turns blue it is alkaline. Normal stools are likely to be slightly acid. Putrid stools are alkaline because of the formation of ammonia. An acid reaction may be due to the presence of lactic acid, acetic acid, or butyric acid or a mixture of acid products.

Normal Contents

A normal stool consists of indigestible or unabsorbed food residues, bile, remains of small residues of unabsorbed digestive fluids, lime, iron and other metallic wastes excreted by the intestine, and bacteria. According to Strassburger, about one-half the bulk of the stool consists of bacteria. The more active the processes of fermentation or putrefaction the greater the number of bacteria. A French observer reported some years ago that in the Arctic regions the feces of many animals show no putrefaction, contain no bacteria, but in other parts of the world bacteria are found in the stools in enormous numbers.

A minute examination of the stool shows the presence of skins, seeds and other indigestible particles, together with minute portions of digestible foodstuffs that have escaped digestion and absorption, such as milk curds, fragments of white of egg, meat fibers, fragments of potato and other vegetables, etc. When nuts are eaten, any portion that is not reduced to a creamy consistency in the mouth is likely to appear in the stools because of the firm texture of these foodstuffs.

Abnormal Contents of the Stools

In diseased conditions the stools present numerous abnormal contents, the most common of which is mucus. The presence of mucus in either large or small amount is an evidence of a diseased condition of the mucous membrane.

When the mucus is broken up into minute particles and so mixed with the stool as to be not easily distinguished, its source is believed to be the small intestine; there is a catarrhal condition of the intestinal tract. Such mucus may be gathered on a rod by stirring the fecal mass.

Large masses of mucus in the form of whitish or yellowish membranes, shreds or flakes, are due to colitis, a catarrhal condition of the large intestine. Colitis may be present, however, even though mucus may not be constantly found present in the stools. Large masses of clear mucus, due to irritation of the rectum, sometimes precede or follow the stool. Mucus mixed with pus appears when ulcers are found present in the lower bowel. When the ulcers are higher up in the bowel the mucus and pus are likely to disappear by decomposition and digestion.

Blood

When fresh blood appears, it is usually due to hemorrhoids or an ulcer within the anal ring. Dark blood mixed with the stool comes from higher up; its origin may be a gastric or a duodenal ulcer. It may also be the result of tuberculosis or malignant disease of some portion of the colon.

Parasites

Fragments of tapeworm, round worms, hookworms, and other parasites are frequently found in the stools. Whenever the presence of intestinal parasites is suspected the stools should

be carefully examined. For large parasites the best way is to wash the stool in a running stream on a fine sieve.

Periodical Examination

Persons who have been subject to constipation, headaches, so-called "bilious attacks," or colitis, and who undertake to combat these conditions by adopting an antitoxic dietary, either with or without the employment of the fruit regimen or the milk regimen to change the intestinal flora, should carefully note the stools from time to time—at least once or twice a week. The appearance of a dark color or putrid odor should lead to a prompt change in the dietary, to cause a disappearance of these indications of a return of toxic conditions. It must be remembered that so long as the stools are putrid in character a condition of chronic toxemia exists. During many hours, while putrid materials remain in the colon, as they often do for days, even, constant absorption of toxic materials is taking place, the circulation of which through the blood gives rise to hardening of the arteries, while their contact with the liver, kidneys and other eliminative organs leads to their degeneration. Premature renal failure, myocarditis, aneurysm, and numerous chronic maladies are due to the same cause. Putrid stools invariably mean a poisoned body; and whether the effects of the poisons are experienced at the moment or not, mischief is being done and the fact will sooner or later appear.

The Intestinal Test Diet

The quantities mentioned below are sufficient for a man six feet in height weighing 180 to 200 pounds. When the test meal is used for smaller persons the amount of the several articles mentioned should be proportionately diminished. *Breakfast:* one and one-half pints of milk, two ounces zwieback, one pint of oatmeal porridge made with one and one-third ounces of dry meal, ten grams of butter and one egg. *Dinner:* one ounce pure gluten biscuit, one ounce of butter, potato soup prepared with six and one-third ounces of potatoes, three and one-third ounces of milk. One-third of the ounce of butter may be added to the potato soup. *Supper:* the same as breakfast.

This intestinal test diet, which is a modification of that employed by Adolph Schmidt, may be advantageously given for a couple of days in connection with a careful study of the stools. By using the carmine and catgut capsules in connection with a test diet a very good idea may be formed of the activity and efficiency of the stomach as well as of the intestinal tract.

The X-Ray Test Meal

Before the discovery of the x-ray little was known of the way in which the intestine performs its work in health and disease. Within the last few years x-ray experts have thrown great light upon this question by the aid of the so-called bismuth or barium meal. This con-

sists of a meal containing bismuth or barium, a harmless substance, and of which a sufficient quantity can be taken in connection with food to cause the contents of the stomach and intestines to cast a shadow. When exposed to the x-ray in this way the form and activity of the stomach and intestine may be visualized upon a fluorescent screen. By means of photography a permanent record may be made. An examination of this kind is essential to a full knowledge of the conditions present in any given case but highly valuable information may be obtained by means of certain tests which are sufficiently simple to be employed without the aid of laboratory experts. The following is a brief description of some of these tests:

Simple Test for Intestinal Motility or Activity

This test is highly important for the reason that normal frequency of bowel movement is not satisfactory evidence of normal bowel action. The colon may be twenty-four hours or even several days in arrears in disposing of its contents. Pouches sometimes form in the colon, particularly in the region of the cecum, in which fecal matters may be retained for several days in succession. Chronic or intermittent diarrhea is not infrequently the result of fecal accumulation. Even when several movements occur daily the colon may never be empty, the diarrhea being due to the fact that a constant or intermittent irritation is set up by fecal matters of which the colon is unable to completely rid itself. The length of time required for food resi-

dues or other material to pass completely through the intestine may be determined in a very simple manner. Proceed as follows:

Have prepared capsules containing five grains each of carmine, a harmless coloring substance. Take two capsules at breakfast, noting the time when breakfast is taken. After taking the capsules note each bowel movement and observe the time when the characteristic color of the carmine first appears. When employing this test it is very necessary to avoid the use of highly colored food of any sort, such as huckleberries, raspberries, or anything having a dark or reddish color. This would cause confusion. When the bowels are normally active the carmine should appear between dinner and supper or at latest before going to bed at night. In many cases the carmine appears the following morning either before or after breakfast. This indicates delay.

After noting the time of the appearance of the carmine, observations of the bowel movements should be carefully continued until the color disappears. In normal persons the color disappears not later than twenty-five hours after it is taken.

In persons who are constipated, the time of appearance and of disappearance of the color is greatly prolonged. Cases are occasionally noted in which the color does not appear until two days after it is taken, while in cases of chronic constipation the time required for disappearance is usually forty-eight hours or more. Sometimes a period of five or six days elapses before the color wholly disappears.

Occasionally it will be noted the color reappears after having disappeared. This may occur two or three times. This suggests a pouched condition of the cecum, or head of the colon, in which the colored fecal matters accumulate. The disappearance of color is due to the fact that the subsequent meal passes over the fecal matter deposited in the pouch without gathering any of the coloring matter with it.

Very finely ground charcoal—or better, bone black—may be used instead of carmine. A teaspoonful of this should be taken dissolved in a little water or milk. Stewed huckleberries or raspberries may also serve as a marker.

This test is a highly important one and gives most valuable information respecting the activity of the intestine. In certain cases the color appears promptly the afternoon of the same day it is taken, but continues to appear for a couple of days, showing that the unusable food remnants and the body wastes accompanying the same are too long retained. This slow disappearance of the color after a prompt appearance is probably indicative of a dilated condition of some portion of the colon. It is usually the right half of the colon that is dilated. This condition is often associated with pains in the region of the appendix. It is likely to give rise to disease of the appendix. The reason for the delay may be either extreme dilatation or a pouched condition of the cecum, or adhesions of the cecum interfering with the contraction movements by which it pushes its contents into the ascending colon.

When the color is slow in appearing—that is, when it does not appear until twenty-four or thirty-six hours instead of appearing the same day it is taken—the cause is very likely to be rectal constipation, a condition in which the lower bowel, and even the rectum, may be so clogged with accumulated and hardened fecal matters as to produce mechanical obstruction to bowel movement. The delay may also be caused by colitis, a condition that usually affects the left half or descending portion of the colon. The irritation produced by colitis causes the bowel to contract so that the passage of material along the canal is hindered. This causes an accumulation in the cecum and right half of the colon, a condition usually accompanied by the formation of large quantities of gas with discomfort from distention due to gas accumulation.

Slow disappearance of the color may be due to incompetency of the ileocecal valve.

When this condition exists the food residues do not advance with the normal promptness and regularity, but oscillate back and forth between the colon and small intestine. X-ray observations have clearly shown this. The small intestine may become empty as the result of the vigorous intestinal activity that accompanies digestion. The next day, however, although no food may have been taken in the meantime, several feet of the small intestine may be filled with the putrefying material that has backed up from the colon. In such cases there is usually obstruction in the left half of the colon, which

may be due to colitis or rectal constipation or may be caused by prolapse and adhesion or incarceration of the pelvic colon.

The slow disappearance of the color may also be due to obstruction at the outlet of the stomach. This condition is often accompanied by great dilatation of the stomach. In such cases twenty-four hours or even longer may be required for the complete discharge of the coloring matter from the stomach. This, of course, will cause delay in both the appearance and disappearance of the color as observed by examination of the stools.

The Milk Regimen

The milk cure in one form or another has been practiced from the earliest times. It was known to the early Greeks and was recommended by Hippocrates several centuries before the Christian era. Hippocrates especially commended milk as a remedy for phthisis and for gout. He was perhaps the first to recommend the addition of water to milk (hydrogala) as a means of increasing its digestibility.

Aretæus, a Greek physician who wrote an extended treatise on acute and chronic diseases in the second century of our era, recommended as a remedy for phthisis the free use of milk, directing that the milk should be prepared by the addition of a fourth part of water and boiling until the mixture was reduced to one-half its original bulk.

Galen made use of cow's milk, of the milk of the goat and sheep, and even woman's milk. He very highly commended milk as a remedy for various diseases and refined the method by requiring that the cow producing the milk should be fed upon certain special herbs.

The renowned Hoffman in the sixteenth century recommended milk as an exclusive dietary, and insisted that the "cure" should be long continued to obtain the best effects.

He especially recommended the milk of cows fed in pastures which abounded with lotus and polygomum. As the patient improved in health

he was allowed to sail down the Tiber and use milk from the cows of Strabiæ.

Baccius, a physician who practiced in Rome in the latter part of the sixteenth century, followed the suggestion of Galen and prescribed for his patients milk from cows fed in pastures in which special plants were cultivated according to prescription.

Health resorts in which the milk cure was practiced existed even in those days. Each invalid was given a goat, an ass or a cow as his source of milk supply and it was part of the duty of the patient to lead his small herd to graze in pastures supposed to be best adapted to his particular case and to take the milk warm direct from the animal.

Sir John Sinclair, in his "Code of Health and Longevity," mentions the use of sour milk as common in Scotland and Ireland. The milk was prepared by permitting it to sour in a vessel placed in warm water after which the whey was turned off and the curds placed in a "plunge churn" where they were churned for some time.

Sydenham and other eminent physicians of his time made large use of milk as a remedy.

Van Swieten especially recommended milk as a remedy for gout, declaring that the victims of this disease would find themselves wholly free from pain so long as they lived upon an exclusive diet of milk.

In modern times the use of milk as an exclusive diet was brought to the attention of the profession by Philip Karell, of St. Petersburg, physician to the Emperor of Russia. A paper

written by this sagacious physician was translated by Carrick, at that time physician to the British Embassy at St. Petersburg, and was published in this country in 1870.

Karell was perhaps the first to systematize the use of milk and to insist upon its use in small doses. He made use of the remedy especially in the treatment of obesity and dropsy, though he commended it as a valuable remedy in many other chronic diseases. On this account he employed small quantities, generally not exceeding three or four pints daily, the object being to reduce flesh or to promote the absorption of dropsical fluids. He did, however, recognize the fact that it was somehow through its influence upon the alimentary canal that the beneficial effects of milk were impressed upon the body. He said,

"I have, after fruitlessly trying all sorts of remedies in many chronic and obstinate diseases, at last succeeded in thoroughly bringing the alimentary canal, that seat of so many diseases, under my control. I did this by administering milk according to a new method."

The writer desires especially to emphasize the fact that the chief beneficial effects derived from the milk regimen are due to its influence upon the alimentary canal; in other words, as will be shown later, to its influence in changing the intestinal flora.

Discovery of the Value of the Bulgarian Bacillus by Doctor Tissier

The idea of using the *B. Bulgaricus* for changing the intestinal flora originated with Tissier.

Poehl, of St. Petersburg, many years before, discovered that a diet of sour milk was the most efficient remedy in cases of diarrhea in children with putrid stools. Under the influence of an exclusive diet of sour milk the putrescent character of the stools rapidly disappeared. The observations of Poehl had been confirmed by many observers and there had been much speculation as to the cause of the favorable results observed. Some attributed the improvement to the casein of milk, others to the lactic acid, still others to the milk sugar, lactose, of which even sour milk contains a considerable quantity.

Grigoroff, working in the laboratory of Professor Massol of Geneva, had discovered in Bulgarian sour milk a large vigorously growing bacillus that produced larger quantities of lactic acid than any organism previously known. In experimenting with this newly discovered bacillus Tissier discovered that active cultures of the organism were capable of preventing the growth of the bacteria of putrefaction and other pathogenic organisms. This is found to be true of the acid-forming bacteria found in ordinary sour milk, but these organisms grow with much less vigor than the *Bulgaricus* and produce a much smaller amount of acid. Observations made upon animals and upon children by Doctor Tissier and Professor Metchnikoff showed that the influence of the *Bulgaricus* in hindering the

growth of putrefactive and other harmful organisms might be usefully employed in combating intestinal putrefaction. This was especially found to be true in children. Professor Metchnikoff had recently made and announced the discovery that the degenerations that are associated with senility and with various forms of disease are the result of the absorption and circulation through the body of poisons generated by pernicious and "wild" bacteria in the intestinal tract. These observations naturally led to the idea of combating old age by the regular and free use of milk soured by the *Bulgaricus*. Metchnikoff himself adopted the practice of taking Bulgarian buttermilk several times a day. He kept constantly upon a table in his laboratory a pitcher of this preparation, called by the Bulgarians "yoghourt," by the Armenians, "Matzoon," and known in Egypt as "leben."

With Metchnikoff's acquiescence, a Paris firm placed upon the market tablets consisting of the dried Bulgarian sour milk which were mixed with sugar of milk. These were sold under the name of "Lacto-bacilline." Combe of Lausanne adopted the idea and with so much success that he was soon receiving distinguished patients from all parts of Europe and acquired great renown.

The writer visited Europe in 1902, soon after Metchnikoff announced Doctor Tissier's discovery, and was able to obtain cultures, and brought the same to this country and has since that time made extensive use of these and similar preparations. Within a few years, through vigorous

commercial exploitation, the ideas of Metchnikoff became widespread throughout the civilized world and the *Bulgaricus* came to be as widely used in the United States as in its native Balkans.

Although many persons experienced considerable benefit from the regular use of cultures of the lactic acid-forming organisms the results were on the whole very disappointing. The good effects produced were not sufficiently regular or pronounced to maintain the confidence in this new therapeutic agent that had been inspired by Metchnikoff. The theory was most plausible and fascinating but the results were more frequently intangible than otherwise. The idea developed by Tissier and Metchnikoff that the intestinal flora must be changed for the purpose of getting rid of the chronic intestinal poisoning which lies at the foundation of the majority of chronic diseases was, however, too rational and practical a notion to be abandoned. More recent experience has shown the advantage of employing also cultures of the *B. acidophilus* and *B. bifidus*, acid-forming organisms which are native to the human intestine and readily establish themselves when conditions are made favorable.

The author's personal experience with lactic acid ferments began some twenty-five years ago. After an initial visit to the Pasteur Institute in 1883, an effort was made to keep in touch with the work of the Institute. Special note was made of the work of the Institute on lactic acid-forming bacilli. An organism that makes only lactic acid was selected and used in preparing a substitute for kumyss. The milk was sterilized, then

inoculated with *B. acidi lactici,* charged with CO_2 and finally allowed to ferment for a few hours to develop the desired degree of acidity. This product was shown at the International Exhibition at Chicago in 1893, and was extensively and usefully employed for a number of years in the treatment of various classes of invalids.

The large clientele of the Battle Creek Sanitarium, consisting chiefly of persons suffering from disorders either produced or greatly exaggerated by intestinal toxemia, afforded an especially favorable opportunity for working out practical methods for accomplishing the result desired. It was evident that to change the intestinal flora was the thing that needed to be done and which must be accomplished. After many hundreds of more or less successful, but not altogether satisfactory, attempts to solve this interesting problem, the simple and successful methods which are outlined in subsequent chapters of this book were at last hit upon and gradually perfected.

Among the changes accomplished by the methods herein outlined are the following:

1. The pernicious poison-forming and disease-producing bacteria, the "wild" bacteria of Herter, are made to disappear, or at least are so greatly reduced in numbers that they cease to exercise a pernicious influence.

2. The putrefactive and other "wild" bacteria, that under ordinary conditions produce in the colon and lower part of the small intestine great quantities of highly virulent poisons, which work enormous mischief in the body, under the new

conditions established by the regime described in subsequent chapters, cease to produce poisons and produce harmless acids, chiefly lactic and acetic acids instead. In other words, the "wild," mischief-making bacteria are tamed or domesticated, and behave like friendly organisms, assuming a protective action essentially the same as that of the *Bacillus Bulgaricus* and other lactic acid-forming organisms.

3. A further change that is effected is the substitution of organisms of a positive beneficial character for the "wild" and pernicious bacteria which throng the intestine in conditions of toxemia and overwhelm the body with noxious products.

That is, the pernicious bacteria which render the change of flora necessary are by the methods here presented:

(1) Eliminated or greatly diminished.

(2) So changed that their action becomes beneficial instead of pernicious.

(3) Displaced by vigorous strains of friendly organisms, the *B acidophilus, B. bifidus* and *B. Bulgaricus.*

Technic of the Milk Regimen

To achieve the best results it is a good plan to place the patient under preliminary treatment for a few days before beginning the milk regimen.

During this period, the length of which may vary from two to ten days, special efforts should be made to get the patient's bowels operating freely.

The bowels should be made to move three or four times a day. This may be accomplished by the use of preparations of bran or agar-agar, or the two combined, together with some suitable preparation of petroleum, such as white Russian paraffin oil. The patient should be required to follow closely the rules for combating constipation (see page 274). If necessary, an enema at 85° to 75° F. may be administered daily for a time until normal action begins.

In many cases, especially when the tongue is much coated and when other evidences of pronounced intestinal toxemia are present, the "fruit regimen" may be employed with great advantage as a preliminary to the "milk regimen." The writer has found this plan of greatest service. After three to five days of fruit regimen the milk regimen is instituted.

The Milk Regimen

Cow's milk is not a natural food for grown-ups, either human or bovine. Milk is deficient in iron, and contains an excess of protein and lime. Cow's milk disagrees with many persons, children as well as adults. It is certainly by no means an ideal food for adults. Yet many persons are marvelously benefited by its temporary use when proper precautions are taken.

The first essential is that the milk should be taken in large amount, so large as greatly to exceed the needs of the body, and thus fill the alimentary canal with material which will promote the growth of friendly bacteria.

A second essential is that the milk shall be taken often. A half pint every half hour is the usual plan. This makes it possible to take into the stomach the five or six quarts of fluid for one day's ration. It is also important to maintain a constant stream of fresh material passing along the alimentary canal, so that a considerable portion may reach the colon undigested and unabsorbed. It is especially important that a sufficient amount of milk sugar should reach the colon unabsorbed to maintain in the colon a state of acid fermentation, thereby preventing putrefaction and changing the intestinal flora. This is, indeed, in many cases, the chief benefit derived from the milk diet. An important fact pointed out by Magnus-Levy is that "the absorption of the various forms of sugar in the intestine proceeds with unequal velocity. This observation, which has been made repeatedly on animals Weinland

has found to hold good for man (Nagano); maltose and dextrose disappeared completely in one hour whereas only 26 per cent of milk sugar, present originally in equal quantity and in the same concentration as the maltose and dextrose, was absorbed during the same period."

To encourage the acid fermentation in the colon it is well to give at each alternate feeding yogurt buttermilk in place of sweet milk; or equal parts of sweet milk and milk soured by the Bulgarian ferment may be taken at each feeding. It is still better to give with each glass of milk a half ounce of a mixed culture of *B. Bulgaricus* and *B. Bifidus.*

Milk Does Not Putrefy

Milk ferments but does not putrefy. This fact has been established by Hirschler, Rovighi, Schmitz, Eisenstadt, and many other observers. The fact that milk also "arrests or diminishes intestinal putrefaction accounts for its absence in milk diet" (Czerny). As a matter of fact, however, milk may encourage putrefaction if constipation coexists. This is due to the fact that undigested curds remain in the colon after the sugar of milk has been wholly absorbed, so that its protective influence in supporting acid fermentation is lost. This makes bran or agar and paraffin oil an essential part of the "milk regimen."

Feedings begin at 7:00 a. m. and end at 7:30 p. m.—twenty-five feedings in all. At 10:00 a. m. and 4:00 p. m. the milk is omitted and a meal of fruit is taken instead. The purpose of this is

to encourage bowel activity, since very free and frequent bowel movement is essential to success. The disappointing results often encountered in the use of the milk diet are chiefly due to the constipation which is likely to be produced in many persons, the natural result of which is intestinal toxemia and an aggravation of the very symptoms from which relief is sought.

Two ounces of sterilized wheat bran or an ounce and a half of agar-agar should be taken daily in half ounce doses, preferably at 7:00 a. m., 11:00 a. m., 3:00 p. m. and 7:00 p. m. feedings.

In cases in which the colon is badly crippled—that is, when there is obstinate constipation—the use of the Russian paraffin oil in doses of one to three tablespoonfuls four times a day is necessary to secure the activity required for a rapid and efficient change of the flora. Paraffin in some form is usually needed.

When the period of exclusive milk feeding is ended, a laxative and strictly antitoxic diet must be adopted.

It should be remembered that the chief advantages of the milk regimen as a means of changing the intestinal flora lie—(1) in the large amount of milk sugar that by this means is carried into the colon and there, fermenting, produces lactic acid and so prevents the growth of the putrefactive bacteria; (2) in the frequent bowel actions induced. The soft curds, undigested and unabsorbed, by their bulk as well as by their acidity stimulate peristalsis to such a degree as to cause several bowel movements daily.

The Use of the Enema

In cases in which mechanical obstacles to bowel action exist, such as incompetency of the ileocecal valve, or adhesions of the pelvic colon, constipation may continue in spite of the largest quantities of milk that can be taken. In such cases the sugar of milk is wholly absorbed, leaving the milk curds to putrefy in the colon. The most intense toxemia may result. The writer has met a number of cases of this sort. This is the chief cause of the disastrous failure of the ordinary "milk cure" in many cases. By a free use of bran and paraffin, combined with the abdominal fomentation and the wet-girdle, success may be attained even in these difficult cases by persevering effort. The colon should be emptied twice daily by the enema. When colitis is present, the warm enema (90°—100° F.) should be used; in other cases the cool enema (85°—70° F.) is preferable. When the bowels begin to move naturally and the stools are no longer putrid, the enema should be used at bedtime only. This should be continued until the tongue becomes clean.

The bowels should move four or five times a day. If for any reason proper bowel action cannot be secured the "milk regimen" must be suspended at once.

Rest

If the patient is emaciated so that a gain in flesh is one of the objects of treatment, complete rest should be maintained during the first week;

not necessarily in bed, but on a cot, or in a wheel chair a part of the time if more agreeable.

During the resting period the patient should take a few deep breaths four or five minutes every hour when awake to counteract the ill effects of lying in bed. The patient should not lie always in the same position. When lying on the back, a cushion should be placed at the small of the back. Sand bags are useful as "props."

The old style of "rest cure," instituted by S. Weir Mitchell, was defective in that it did not provide systematic and graduated exercise. It made patients obese, but not strong. (Zuntz.) Graduated exercise should be begun after the first week (see page 292).

The patient must spend every possible moment out of doors, day and night.

Feeding Schedule

Milk is given at twenty-four feedings and fruit at two (10 a. m. and 4 p. m.), with lettuce and celery when the additional bulk is well tolerated. Bran and paraffin are taken four times a day. In most cases it is best at first to give the milk at intervals of an hour for a day or two then every forty minutes for another day. When the full regimen is established, the following schedule is followed:

Feeding Schedule for One Day

Time of feeding	Food taken
7:00 A. M.	Fruit, bran, paraffin
7:30 "	Milk
8:00 "	"
8:30 "	"
9:00 "	"
9:30 "	"
10:00 "	"
10:30 "	"
11:00 "	Milk, bran, paraffin
11:30 "	"
12:00 "	"
12:30 P. M.	"
1:00 "	"
1:30 "	"
2:00 "	"
2:30 "	"
3:00 "	Fruit, bran, paraffin
3:30 "	Milk
4:00 "	"
4:30 "	"
5:00 "	"
5:30 "	"
6:30 "	"
7:00 "	Milk, bran, paraffin
7:30 "	"

Amount of Milk Taken Daily

The amount of milk taken daily must depend upon the capacity of the patient. It is clearly necessary to take fully double the amount of milk actually needed for nourishment. The ratio to body weight is about one and one-half ounces of

milk to each pound of body weight. The following table shows the aggregate amounts for different sized feedings:

At each feeding	Total
4 oz.	6 pints
4 ½ "	6 ¾ "
5 "	7 ½ "
5 ½ "	8 ¼ "
6 "	9 "
6 ½ "	9 ¾ "
7 "	10 ½ "
7 ½ "	11 ¼ "
8 "	12 "

Food Value of the Daily Ration

The total food value in calories of the full regimen (6 qts.) is not far from 4,000 calories, of which one-half is fat, one-fourth casein and one-fourth milk sugar; that is, 2,000 calories of fat, 1,000 of protein, and 1,000 of carbohydrates.

The fat and milk sugar are more completely utilized than the casein. The body can store up almost any amount of sugar and fat in the form of adipose tissue and glycogen, but only a very limited amount of protein. This is especially true while the patient remains in a state of rest. Protein can not be retained unless it is utilized by entering into the composition of the living tissues of the body—the glands, the nerves, blood and muscles. Not more than two hundred to three hundred calories per day can be used for this purpose, so that several hundred calories of casein must be lost in the stools. The loss is

not complete, however, for the soft, slightly acid curds have a highly beneficial effect upon the diseased surfaces of the colon, suppressing the growth of pernicious bacteria, and gathering them up and sweeping them away by stimulating intestinal activity.

In the exceptional cases in which a larger amount of milk is needed, an extra quart may be added by giving feedings at 8:00, 8:30, 9:00 and 9:30. These extra feeding hours may also be utilized to make up the full amount needed in cases in which the patient is not able to take so much as 8 ounces at each feeding.

In exceptional cases feedings may be given at midnight, 2:00 A. M., 4:00 A. M. and 6:00 A. M. It is better, however, in general, to allow the stomach an opportunity to rest during the night. Within about eight hours after the last feeding the stomach and small intestine should be empty of food, thus giving the digestive tube and its secreting glands an opportunity for complete rest during five or six hours. Glands, like muscles, need rest to enable them to replenish their stores of energy.

How the "Milk Regimen" Differs from the "Milk Diet"

There are several important particulars in which the "milk regimen" differs from the "milk diet," or ordinary milk feeding, and these points are so important that we shall give brief attention to each one, and endeavor to make clear why the "milk regimen" may be expected to suc-

ceed in cases in which the so-called "milk diet" has failed.

Cases are, indeed, very rare in which the milk regimen can not be employed with success, even though the patient's former experience may have been such as to justify the expectation of failure. The only cases, in fact, in which the milk regimen is positively contra-indicated, are those in which the individual has been sensitized to milk protein.

The milk regimen differs from ordinary milk feeding, especially in the following particulars:

1. It is a thoroughly systematized method. In ordinary "milk feeding," it is a common practice with physicians to say to the patient, "Take all the milk you can at meals and between meals." That is, the milk is simply added to the ordinary bill of fare. This method occasionally succeeds fairly well in securing a gain in weight when this is the chief object sought, but not infrequently, perhaps in a majority of cases, the patient soon finds his digestion upset. Appetite disappears, the bowels become inactive, the tongue coated, and pronounced symptoms of intestinal toxemia appear.

When milk is taken in this desultory manner, it is likely to promote rather than to combat putrefaction in the colon. In cases in which a normal or excessive amount of free hydrochloric acid is produced by the stomach, large tough curds are likely to be formed, which, finding their way into the colon, furnish a favorable medium for the development of the putrefactive organisms that abound in this part of the alimen-

tary canal. This is particularly likely to occur if the milk is taken between meals, for then it enters the stomach at a time when a large amount of highly acid gastric juice is present, a condition favorable to the production of large indigestible curds.

The increase of intestinal putrefaction increases the constipation and resulting toxemia that destroys the appetite and gives rise to malaise, headache, and other distressing symptoms. Thousands of persons have learned from experience that milk, when taken in connection with other foods, produces the disagreeable symptoms above noted. When taken in sufficient quantity and as an exclusive article of diet, these symptoms do not appear, for the following reasons:

(a) The quantity of milk taken is so great that the lime and casein present neutralize the acid of the gastric juice and diminish the intensity of the action of the rennin, so that the curds formed are soft and friable and easily broken up.

(b) When milk is taken in connection with an ordinary diet, the quantity is so small and its movements along the intestine so slow that the milk sugar present is all absorbed before it reaches the colon. Thus the undigested curds present are not protected from the action of putrefactive bacteria, but are left to undergo decomposition. When taken in the quantity prescribed by the milk regimen, the whole alimentary canal is flushed with milk in which the lactic acid fermentation begins before the colon is

reached, and the movement toward the colon is so rapid that a considerable part of the large amount of milk sugar taken reaches the colon. The twelve pounds of milk usually taken by the patient in the milk regimen contain about half a pound of milk sugar. A sufficient amount of this will reach the colon to maintain acid fermentation by which the growth of the putrefactive organisms is prevented. Bienstock, Tissier, and Martelly have shown that when sugar is present to the extent of one per cent the growth of putrefactive bacteria is prevented, provided acid-forming bacteria are also present. Careful chemical analysis of the stools of patients taking the milk regimen shows the presence of sugar to the extent of one per cent. In a case in which a fistulous opening existed in the intestine just above the ileocecal valve, the amount of lactose found present in the intestinal contents with patient taking the milk regimen was nearly five per cent. That is, the food residues of the small intestine which were just ready to enter the colon, contained an amount of sugar amply sufficient to protect the contents of the colon against the action of putrefactive bacteria.

2. The frequency with which the milk is administered plays a highly important part in the success of the milk regimen. Each time the milk is taken a new impetus is given to the peristaltic activity of the stomach and the intestine. Fresh food entering the stomach sets up active peristalsis the whole length of the alimentary canal. This serves an important purpose in getting a sufficient quantity of lactose

into the colon to support the active growth of acid-forming bacteria. Carmine given at the seven o'clock feeding to a patient on the milk regimen will usually make its appearance in the stool within 14 hours and may disappear within 25 hours. (Compare this time with the average figures.)

As elsewhere stated, the sugar of milk is very slowly absorbed in the human alimentary canal, especially in the intestine of adults. Maltose, the sugar produced by the action of the saliva and pancreatic juice upon starch, is absorbed in one-fourth the time required for the digestion and absorption of the same quantity of milk sugar.

3. Peristaltic activity is increased with the "milk regimen" and decreased with the ordinary "milk diet." When used in the ordinary way, milk is generally found to be constipating. Some persons note laxative effects from the use of buttermilk, although this is not uniformly the case. Raw milk, and especially boiled milk, is almost universally regarded as constipating. There are two reasons for this:

(1) When milk is well digested, no residue is left behind to stimulate peristaltic activity.

(2) If it is not well digested, the curds that pass into the colon produce putrefaction with the production of ammonia and other putrefaction products, the effect of which is to paralyze the colon and produce constipation.

The older writers on the milk diet call attention to the fact that patients taking the milk cure were constipated, and even referred to the con-

stipation as a good indication. Some modern advocates of the milk diet have expressed the same view. This is a grave error and this is an important point in which the "milk regimen" differs from the so-called "milk cure." One writer even goes so far as to recommend that the "call" for evacuation of the bowels should be resisted and postponed so as to secure a large movement the next day. Nothing could be more absurd. One bowel movement a day is constipation. The bowels should always move three times a day, and a person on the "milk regimen" should have at least four bowel movements daily. A steady stream of sour milk must pour along the intestinal canal. In this way the old flora or "meat bacilli" (Herter) and other "wild" bacteria, may be driven out and the new beneficent, acid-forming flora may be established.

Especial care must be taken so to manage the milk regimen as to secure a very decided increase of peristaltic activity. It is by this means alone that the necessary carbohydrate (milk sugar) may be made to reach the colon, a condition essential for changing the intestinal flora. Increased peristalsis is also one of the most important measures for securing a change of the intestinal flora by preventing stasis or stagnation of the intestinal contents, which, more than any other condition, promotes putrefactive changes. In exceptionally favorable cases, the administration of a glassful of milk every half hour will produce a sufficient degree of intestinal activity to accomplish the desired end; but in a large majority of the cases in which the milk regimen

may be of service, such obstinate constipation exists that it is necessary to employ additional means for securing the necessary degree of intestinal activity. In these cases, incompetency of the ileocecal valve, a spastic condition of the distal colon, adhesions of the pelvic colon or some of the several forms of rectal constipation —any one of these conditions, or a combination of several, may be present.

On this account, the employment of special means for increasing intestinal activity has been found to be highly advantageous. It is for this reason that bran or agar-agar, with white refined paraffin oil in some form, should be employed in sufficient quantity to insure vigorous peristaltic activity. The bowels should be made to move three to five times daily. In the exceptional cases in which the bowels move too frequently the quantity of milk must be lessened.

It is only by this thorough flushing and scouring of the intestine that the pernicious putrefactive organisms can be driven out and the beneficent ferments established. The colon must be constantly flooded with fermenting carbohydrate.

4. It has been found decidedly advantageous to allow the patient two meals of fresh fruit, one in the forenoon, the other in the afternoon—at 10 a. m., and 4 p. m. The usual glass of milk is omitted and the patient is allowed to take, instead, fruit of any kind for which he may have a fancy. Fresh fruits are, however, decidedly preferable, particularly strawberries and juicy fruits of all sorts. Great care must be taken to masticate the fruit very thoroughly. Lettuce

and celery may be added to the fruit meal without any disadvantage in most cases, and with great advantage in many cases. These foods require almost no digestive activity, while they supply vegetable acids, together with carbohydrates, which aid in establishing the acid-forming bacteria in the colon, as well as vitamines, iron, and various salts that promote the patient's nutrition. The alkaline salts furnished by fruits are particularly valuable to combat the slight tendency of the milk regimen to disturb the equilibrium of the body fluids as regards the exact balance of acids and bases.

Another advantage of the "milk regimen" depends upon the fact that casein is a form of protein of which the body can make use with a very high degree of economy.

"Caspari found both in the dog and man a greater nitrogen retention after addition of casein to the diet than after a corresponding amount of flesh" (Milroy).

Practical Suggestions

Rest During the First Week

When a gain in flesh is one of the chief objects desired to be attained by the use of the milk regimen, the patient should take very little or no exercise during the first week. It is not necessary that the patient should stay in bed as some have insisted. It is only important that he should avoid active exercise. Even moderate exercise may increase metabolism from twenty-five to

fifty per cent. The energy thus consumed in muscular activity diverts a definite amount of nutritive material which has been digested and absorbed, and consumes instead of storing it. The patient should not walk about or engage in occupation of any kind, and should avoid even light work. Generally, the patient may read, chat, and entertain himself, and may be entertained with music and in other ways, but should avoid violent excitement of all sorts and should sleep as much as possible.

Back Support During Rest in Bed

Care should be taken to see that while the patient lies in bed the trunk is properly supported by a firm cushion placed at the small of the back. When this precaution is neglected patients who lie long in bed often suffer from subluxation, or strain, of the sacro-iliac synchondrosis, the joint formed by the junction of the sacrum and the lateral bones of the pelvis. Many patients when lying in bed suffer from backache due to lack of back support.

It is also wise for the patient to lie with the body inclined toward the right side. This position facilitates emptying of the stomach, especially in cases in which the stomach is dilated or prolapsed. If nausea is present, the patient should lie upon the left side to prevent strain upon the cardiac orifice (Brunton).

Absorption of the digested food material from the intestine may be greatly promoted by application of pressure upon the abdomen. In the

majority of cases in which the milk regimen is employed, the patient will be found to have very relaxed abdominal muscles and in consequence the intra-abdominal pressure is greatly diminished if not altogether absent. This greatly hinders the absorption of the digested foodstuffs. By the application of a sand bag or a shot compress to the abdomen the necessary pressure may be secured and absorption greatly facilitated.

Instead of applying weight to the abdomen the patient may obtain essentially the same result by lying upon the face so that the abdomen will be compressed by the weight of the body. By lying over a cushion or a pillow the effect of the prone position may be greatly increased.

Sand Bag Props

Sand bags weighing ten to twenty pounds are of great service in supporting the patient in a position of complete relaxation and rest. More than half the internal work of the body is due to muscle tension. Lying in bed is often far from being the complete rest that one naturally conceives it to be. The evidence of this is seen in the fact that the patient gets tired and most uncomfortable and requires frequent change of position.

The chief cause is undue muscle tension, due to unconscious muscular effort in maintaining the body in position. That this is considerable is shown by the instant relief and sense of comfort experienced when sand bags or other suitable "props" are properly applied.

The tendency to slip down in bed if the head and shoulders are raised even a little is unconsciously antagonized by involuntary muscular action involving waste of energy. This may be easily prevented by a twenty pound sand bag placed against the buttocks. When the patient lies upon the side the addition of a couple of ten pound bags placed against the small of the back and the shoulders gives the patient a feeling of support and security that is most agreeable and restful. In many cases an additional bag placed in front against the lower abdomen is highly advantageous. If pain is present, or if colitis and a spastic condition of the colon exist, a warm or hot bag in front (especially the lower left side) is most useful, relieving pain and relaxing the contracted bowel at the same time that it gives support and compresses the relaxed and distended abdomen.

Surrounded by these supports, the sense of tension that makes patients restless in bed and keeps them turning from side to side or otherwise changing position is soon lost and the patient feels at perfect rest, cradled in a comfortable nest in which he may relax completely and thus save a useless waste of energy that will not only hinder the accumulation of fat, but will also interfere with the storing up of energy in the cells of the brain and spinal cord, one of the essential aims of the "rest cure" in these cases.

Raw Milk Must Be Used

Sterilized or pasteurized milk should not be used, for the reason that such milk is lacking in qualities that are essential to nutrition. Heat destroys the subtle vitamines that are essential to good nutrition; hence only fresh, clean or raw milk should be used. Another point of still greater importance is the fact that heating destroys the acid-forming organisms that are contained in milk, and that are absolutely essential for changing the intestinal flora. In pasteurized, and even sterilized milk, these beneficent acid-forming organisms may be destroyed, while the bacteria that produce putrefaction, and such infections as colitis and enteritis, may still remain active.

If in any case it seems absolutely necessary to employ sterilized or pasteurized milk, the acid-forming organisms may be supplied by adding pure cultures of the *B. Bulgaricus,* or combining with the pasteurized milk a liberal proportion of yoghourt buttermilk.

Some writers on the milk cure have insisted that the cup or glass from which the milk is taken should be used for twenty-four hours without washing, it being claimed that better results are obtained by this plan than when a clean glass is used each time. The unwashed tumbler soon becomes sour and thus will encourage the development of acid-forming organisms in the milk after it is swallowed. If, however, a certain proportion of sour milk or of yoghourt buttermilk is employed, the same result will be obtained

without sacrificing the luxury of a clean drinking glass. If sour milk is used it should be made smooth by thorough churning or beating with an egg beater before adding it to the milk.

Holstein Milk Preferable

It is well-known that there is a marked difference in the quality of milk furnished by different breeds of cattle. Cattle of the Holstein breed furnish a milk containing a moderate amount of fat, while Jersey cattle furnish a milk in which the fat content is very much larger. Microscopic examination of the two varieties of milk show also that there is a difference in the fat globules, the globules in Holstein milk being much finer.

There has been much discussion as to which of these two varieties of milk is best adapted to milk feeding of infants and invalids. It seems to be pretty well settled among those who have had considerable experience in milk feeding that an excess of fat is decidedly injurious, lessening digestibility and encouraging intestinal putrefaction. It is important also to remember that in employing the milk regimen for the purpose of changing the intestinal flora, the milk sugar is an element of primary importance, since it constitutes the food of the acid-forming organisms, the re-establishment of which in the colon is necessary for a change of the intestinal flora. The Holstein milk contains a liberal supply of sugar, and the smaller amount of fat is a decided advantage. For many years, the only milk employed for table use in the feeding of patients

in the institution under the writer's supervision has been that supplied by a fine herd of Holstein cattle and produced under the conditions required for certified milk.

Too much emphasis can not be put upon the importance of avoiding miscellaneous feeding in connection with the milk regimen. Fruits may be used to advantage, for reasons given elsewhere, while in most cases even lettuce and celery may be employed to advantage.

Incompatibility of Milk and Meat

Miscellaneous foodstuffs, particularly meat and eggs, must be carefully avoided, not only on account of the excess of protein which their use involves, but, in the case of meat, on account of the stimulating effect of meat upon the gastric glands. Pavlov demonstrated that the use of meat excites the acid-forming glands of the stomach to a very high degree, the result being the production of a highly acid gastric juice. The reason for this is that meat requires a highly acid gastric juice for its disinfection and digestion. Milk, on the other hand, requires a gastric juice with a low degree of acidity. Consequently, these two articles of food are naturally incompatible, and there is something more than a mere ceremonial significance in the ancient law of the Hebrew race, which for many thousands of years has required strict adherence to the rule that the eating of meat and milk or milk products at the same meal should be strictly prohibited. Even at the present time an orthodox Jew strictly abstains from eating milk in any

form when flesh foods form a part of the bill-of-fare.

Nothing could be more opposed to plain physiologic principles than the recommendation of certain advocates of the rest cure that large quantities of beefsteak and eggs should be combined with the use of milk. Recent very careful studies of the dietetic properties of raw eggs have shown that the raw white of eggs is not only very indigestible but that it hinders the digestion by absorbing pepsin.

The Quantity of Milk to be Taken

The amount of milk taken in twenty-four hours must vary somewhat in accordance with individual capacity and needs. In general, a small person has a smaller digestive capacity than a large person. A good rule, in the writer's experience, is to give the patient for each twenty-four hours, one and one-half fluid ounces of milk for each pound of normal body weight. When the patient is not taking the full ration of milk, milk sugar should be added in proportion of an ounce and a quarter for each quart less than the full ration.

The Normal Weight

The normal weight of persons of different heights is shown in the following table:

Men		Women	
Height In in.	Weight In Pounds	Height In in.	Weight In Pounds
61	131	59	119
62	133	60	122
63	136	61	124
64	140	62	127
65	143	63	131
66	147	64	135
67	152	65	139
68	157	66	143
69	162	67	147
70	167	68	151
71	173	69	155
72	179	70	159
73	185	71	164
74	192	72	169
75	200	73	175

It is not necessary that the full amount of milk should be taken the first day. Generally, in fact, it is a good plan to begin by giving the patient the first day half the maximum quantity which he is expected to take, the second day three-quarters this amount, and the third day the full amount. In some cases it is necessary to progress more slowly, reaching the maximum quantity only by the fifth or sixth day.

A person of average weight—say 125 to 130 pounds—will take six quarts of milk a day between 7 a. m. and 7:30 p. m., twenty-four feedings of eight ounces each. In case additional feedings are required, such additional half hour feed-

ings may be given between 7:30 p. m. and the retiring hour as may be necessary to make up the required amount. A small person with a normal weight of, say, ninety pounds, would require a milk ration of 135 ounces, or six ounces at each of the twenty-four milk feedings. A normal weight of 110 pounds would require seven ounces at each of the twenty-four feedings. It is not necessary, of course, that minute exactness should be observed in relation to the quantity of milk taken, but it is important to know the maximum requirement in each case and to approximate this quantity as nearly as possible to secure the best results. This rule does not apply, of course, to the feeding of obese persons. Special directions for such cases will be given later.

Care of the Mouth

The mouth should be cleansed by rinsing well with water after each feeding. It is well also to rinse the mouth several times a day with cinnamon water. This may be easily prepared. Put into a pint bottle a tablespoonful of calcined magnesia. Add to this two teaspoonfuls of cinnamon essence. Fill the bottle half full of water and shake vigorously two or three minutes. Then fill the bottle with water and mix, and it is ready for use. Shake each time before using. A weak solution of peroxide of hydrogen is also highly valuable for mouth disinfection.

When proper care is taken to keep the mouth clean the milk regimen greatly promotes the

health of the teeth. Pyorrhea, if not too far advanced, will sometimes disappear after two or three weeks of milk regimen. Decay of the teeth has been shown to be, in part at least, the result of a deficiency of lime in the saliva. The milk not only itself contains lime in abundance, but replenishes the body's stores of lime and so increases the amount of lime in the saliva. When the teeth are constantly bathed with a saliva which is rich in lime salts, the decay already started is arrested and new foci of decay do not appear.

Exercise and Baths

Feeble patients who can not exercise should have automatic exercise after the first week. Those who are able to do so should walk a definite distance daily—the first day twenty rods, the next forty rods, the next day eighty rods, so increasing the distance each day up to three or four miles. The full distance need not be walked at one time. Not on any account must the patient be allowed to become greatly fatigued. Swimming and various special exercises and exercises upon the inclined plane are of special value.

An electric light bath may be given daily with advantage. Sweating should continue only three or four minutes and should be followed by a cold towel rub or a cold shower and massage.

The Results

The tongue becomes clean, breath sweet, the stools are no longer offensive, and usually have a yellow color and little odor or a slightly sour odor. This change is generally observed within a week or ten days, and even sooner when the bowels move very freely. The skin clears, the blood improves, the patient gains in flesh, often a pound a day, and the old depression, headache, mental dullness, and other miseries are replaced by a sense of energy and well-being. The transformation of the patient from a poor, emaciated, despairing invalid to a plump, rosy cheeked, bright, forceful person is often so rapid as to seem almost miraculous.

This rejuvenating process sometimes continues for two or three months if the regimen is faithfully carried on and modified to meet the patient's changing needs. A gain of twenty-five to thirty pounds in six or eight weeks is not uncommon. Sometimes a gain of forty pounds is made in as many days. This is easily accounted for by the large amount of lactose found in the ration. One ounce of sugar absorbed in addition to a full ration may cause an increase of flesh amounting to four ounces. Fats only add their own weight and proteins when assimilated to the maximum add not more than half their weight to the body weight.

Methods of Overcoming Special Difficulties

Some people experience more or less difficulty in taking milk, especially at first. Many such persons generally object when the milk regimen is proposed, saying, "I cannot take milk. I have avoided milk for years. It always disagrees with me."

In such a case it is necessary to inquire carefully into the symptoms noted by the patient so as to find the cause of "disagreement" in the particular case in hand. Are the symptoms located in the stomach, or are they indicative of intestinal toxemia? It is highly important to settle this question and others of like character, and to be able to assure the patient that each of the obstacles presented may be certainly and completely overcome.

The following amusing explanation of the disturbances experienced by novices in the use of the milk diet was seriously offered by an empirical writer on milk feeding:

"The troubles are only the natural explosions due to the revolutions going on in the stomach."

This reminds one of the explanation given by an attendant at a famous European resort, the waters of which were advertised to cure all diseases. When asked for the rationale of the action of the water the attendant promptly replied, "The electricity of the water combines with

the magnetism of the body and explodes the disease."

Although the chief obstacle is often purely psychic and must be removed by "suggestion" and tact, real difficulties are frequently encountered and must be met in a rational way. Here are a few suggestions:

Dislike for Milk

One of the great difficulties encountered in employing the milk regimen is the dislike many persons have for milk. With some persons the repugnance for milk is so great that considerable effort is necessary to overcome it. When the objection is to the taste of milk the difficulty may be overcome by the addition of some flavoring substance, such as a small amount of cereal coffee or a decoction of some simple herb, like sage or thyme. Fruit juices may be employed with advantage. The juice of sweet apples, grape juice, orange juice and the dilute juice of limes or lemons may be used for the purpose as also the juice of dried fruits, as blackberries, raspberries or prunes.

Nausea and Vomiting

The most serious difficulty encountered in milk feeding is the occurrence of nausea or vomiting. This is usually the result of taking the milk too rapidly, or taking too small a quantity. It may seem absurd to suggest that if a small amount of milk produces nausea a larger amount

will be likely to produce the opposite effect. This is nevertheless the case. The writer's attention was called to this fact many years ago by the distinguished New York surgeon, Dr. Stephen Smith, who told the writer an interesting story of an observation made when he was a boy. He noted that his mother in making cheese took great care to weigh both the rennet extract and the milk. He asked his mother why she was so particular to get exactly the right quantity of each in making the cheese. Her reply was, "If I have too much rennet the curds will be too hard, and if I have too little the curds will be too soft."

The lesson of this simple observation is very plain. The nausea and vomiting are due to the presence in the stomach of undigested curds of which the stomach is unable to dispose. In normal digestion, the food leaves the stomach in a fluid state after having been acted upon by the saliva and gastric juice. Milk is not ordinarily digested in the stomach but is reduced to the consistency of a thin gruel which passes through the pylorus without difficulty; but large, tough curds are retained in the stomach and produce the effect of foreign bodies, causing nausea, which is incidental to the effort of the stomach to dispose of its objectionable contents by vomiting. Milk in sufficient amount to neutralize the gastric acid will not form tough curds.

Pain

Instead of nausea, or with it, the patient sometimes experiences pain and great discomfort from an excess of gastric acid and violent efforts on the part of the stomach to force the tough masses of casein through the pylorus. The excess of acid causes tight closure of the pylorus, so that the efforts of the stomach are not successful, and the result is often severe pain as well as nausea or vomiting and increasing discomfort. The patient usually loses appetite and refuses to proceed farther, declaring that milk disagrees with him.

The remedy for these troubles is found in encouraging the patient to take a larger quantity of milk. By persevering effort the unpleasant symptoms, one by one, will soon disappear in almost all cases. It is nearly always a mistake greatly to reduce the quantity, for, as above pointed out, the difficulty is best overcome by increasing the quantity. When a larger quantity of milk is taken the hydrochloric acid is neutralized by the lime and the casein; the curds formed are small, flocculent, and easily broken up instead of forming in tough masses. Thus the milk passes quickly from the stomach and in the course of a few hours the whole alimentary canal will be bathed with the bland lacteal fluid carrying millions of acid-forming organisms and the milk sugar necessary to promote their luxuriant development in the colon.

Under these favorable conditions, the numerous varieties of streptococci or pus-forming

germs and other infectious micro-organisms that give rise to gastritis, enteritis, catarrhal conditions of the gall ducts, pancreatic ducts and colon, cease to develop and the diseased surfaces are by the natural curative powers of the body rapidly restored to a normal state.

If vomiting occurs, the presence of curds may be regarded as an evidence of excessive acidity. In such cases bicarbonate of soda may be added to the milk in proportion of ten grains of soda to each glassful of milk. After a few days the soda may be omitted, as the acid-forming glands of the stomach will soon make less acid as the gastric irritation is lessened.

The Milk Must Be Taken Slowly

Taking the milk too rapidly is a frequent cause of gastric disturbance. It is of the highest importance that the milk should be taken slowly as directed. It may be slowly sipped with a strong suction action, or better still, it may be drawn through a straw. Experiment shows that when milk is taken in this way the amount of saliva mixed with it is several times as great as that when it is swallowed as one ordinarily drinks water. Milk should never be taken as a beverage. It must be taken as a calf or an infant takes it, with a sucking movement, which insures proper insalivation. Milk requires a liberal admixture of saliva to insure normal digestion.

The Proper Temperature

In some cases it is found necessary to take the milk warm instead of cold, or at a temperature near that of the body, say 102 to 105 degrees. When taken at this temperature, the stomach seems to relax more readily to accommodate the milk. When taken cold, a certain sensation of fullness in the stomach due to failure of the stomach to relax, sometimes leads the patient to protest that the stomach is already full and can not receive more. This sensation usually disappears at once when the milk is taken warm. In heating the milk, care should be taken not to raise the temperature above 115 to 120 degrees. A higher temperature is likely to injure the vitamines, which are highly essential to the most favorable results.

A convenient way of heating the milk is to place the bottle containing it in a basin of hot water, covering the whole with flannel. A small electric heater which may be placed in the bottle or in a tumbler containing the milk is a great convenience.

Skimmed Milk

In certain cases in which the stomach is sensitive to fats it is found advantageous to give skimmed instead of full milk or milk from which a part of the cream has been removed. Similar results may be obtained by diluting the milk with water and adding milk sugar. For example, the milk and water may be mixed in equal quantities

and the milk sugar added in the proportion of two ounces of milk sugar to a quart of the mixture.

The Use of Buttermilk

Patients who are fond of sour milk may use buttermilk, or beaten sour milk, instead of ordinary sweet milk. A mixture of equal parts of milk and buttermilk may be used. Buttermilk prepared with Bulgarian bacillus is much to be preferred.

If buttermilk is not obtainable, the patient should take with each glass of milk a couple of tablets containing active cultures of the *B. Bulgaricus.*

Some patients prefer to use the fresh milk and buttermilk in alternation.

An excellent quality of yogurt buttermilk may be prepared by giving attention to the following directions:

First, sterilize the milk. The milk should be boiled about five minutes. If cooked until a slight scum rises on the surface, this is sufficient.

Second, cool the milk. The boiling point is about 212°. The ferment is likely to be destroyed by a temperature of 150°. For safety it is necessary to cool the milk to a temperature of about 115°. This may be done by allowing it to stand until sufficiently cooled or by placing the vessel containing it in cold water.

Third, ferment the milk. Yoghourt tablets contain the active ferment in a latent form. It takes a few hours for them to develop activity.

For rapid growth it is necessary that the temperature of the milk should be maintained at about 115°. At a lower temperature, the *B. Bulgaricus* grows very slowly or not at all; but at 115° the development is rapid. Many fail in the attempt to make yoghourt buttermilk because of their ignorance of the fact that this Oriental milk ferment requires a much higher temperature for growth than do the ordinary milk-souring ferments.

The so-called buttermilk tablets that are sold about the country grow quickly at a low temperature and so sour the milk readily, but they are of less value in combating intestinal autointoxication.

An excellent plan, perhaps the best, is to add to each glassful of milk a tablespoonful of a fresh, pure culture of *Bacillus Bulgaricus* and *Bacillus bifidus.*

When Milk Causes Gas

Patients sometimes complain of inability to take milk because of the formation of quantities of gas that distend the bowels and produce discomfort. The cause of this is stasis. The intestinal contents are delayed in some part of the alimentary tract and as a result of the stagnation fermentation with the formation of gases occurs. The worst cases are those in which incompetency of the ileocecal valve exists. This condition is usually associated with prolapse, with adhesions of the pelvic colon or a spastic condition of the descending colon, or both these conditions together. In many cases there is in

addition a sacculated state of the cecum, the so-called movable cecum of Wilhms or adhesions of the cecum. The gas accumulation is in both the colon and the small intestine when the ileocecal valve has become incompetent. The gases naturally force their way back into the small intestine and the distension of the abdomen is most pronounced in the region of the umbilicus.

In these cases the patient observes that it is impossible to get rid of the gas. When the gas accumulation is confined to the colon, the ileocecal valve being competent, quantities of gas will at intervals be discharged from the colon, after which the patient will experience relief. But when the ileocecal valve is incompetent, contraction of the colon results in forcing the gas back into the small intestine instead of discharging it through the anus. For immediate relief in these cases a warm enema should be administered. The water should be introduced slowly, with the patient lying upon the back or in the knee chest position. At least five or six minutes should be occupied in filling the colon.

The fountain syringe is best for the purpose. The level of the reservoir should be not more than two feet above the level of the body. When introduced slowly in this manner the water is certain to find its way to the cecum. When the water introduced is not wholly expelled within a few minutes, the colon may be made to contract more efficiently by introducing one or two pints of water at a temperature of 80°. The lower temperature has the effect to stimulate the muscular walls of the intestine, thus emptying it.

In some cases it is necessary to repeat the enema several times to secure complete emptying of the colon.

Coated Tongue

In certain cases the tongue becomes thickly coated a few days after the beginning of the milk regimen. The appearance of the tongue may be white, brown or yellow. The surface is usually moist.

The breath is sometimes fetid and has a strong fecal odor. In these cases the cause of the coating of the tongue is usually stasis in the colon and putrefaction with the consequent absorption of toxins. In the majority of cases there is an incompetent condition of the ileocecal valve, resulting in the backing up of fecal matters into the small intestine, where the putrefaction poisons present are readily absorbed.

The coated condition of the tongue is due to the fact that when the blood is charged with toxins the resistance of the blood and other fluids is lowered, the saliva loses its power to inhibit the growth of micro-organisms, and the mouth becomes an incubating chamber in which molds and bacteria of various sorts grow luxuriantly. When the bowels become active, moving three to five times a day, the tongue soon clears off. The colon should be cleansed by enema once or twice daily.

When the tongue is coated at the beginning, which is not infrequently the case, it should be gotten clean or nearly so by a course of fruit regimen for a few days before beginning the milk

regimen. When the tongue becomes clean or nearly so, the breath sweet and the stools comparatively free from odor, the patient is ready for the milk regimen.

In some cases it is best to interrupt the milk regimen and put the patient on a fruit regimen for a few days until the tongue clears, then resume the milk.

If the patient is put upon a milk regimen without having the preliminary fruit regimen he is much more likely to suffer inconvenience from the use of milk and frequently nausea, vomiting and constipation occur; the patient gets discouraged and gives up the attempt. This rarely occurs when the patient is properly prepared by means of the fruit regimen, which lessens the putrefactive flora and gets the bowels moving well.

Diarrhea

Diarrhea is generally caused by stasis or retention of fecal matters in some part of the colon, usually the cecum and ascending colon. This is always true when the diarrhea is accompanied by much gas formation. It may be relieved by taking a hot enema, two or three pints, at a temperature of 102° F. once or twice a day.

When the diarrhea is acid, use boiled milk for every other feeding. Omit the use of buttermilk if it is employed. If the stools have a rancid smell the fat must be lessened. Use skimmed milk altogether or at every other feeding, or employ a mixture of equal parts of full and skimmed milk.

If the stools are putrid, give more carbohydrate—starch and milk sugar. A rounded teaspoonful of milk sugar may be added to each glass of milk, or the patient may take at the ten o'clock and four o'clock feedings two ounces of oatmeal and bran cooked for four minutes. These patients are greatly benefited by the use of enemas of whey containing an active culture of the *B. Bulgaricus.*

Constipation

Perhaps the most frequent and the most serious obstacle in the way of milk feeding is constipation. If milk is taken in small quantity, constipation is certain to result. It is only by taking the milk in quantities sufficiently great to furnish a large residue of undigested curds that constipation may be avoided. In fact, in cases in which the colon is greatly crippled by adhesions, dilatation of the cecum, incompetency of the ileocecal valve, prolapse and incarceration or adhesions of the pelvic colon or a spastic condition of the descending colon, it is often impossible to secure proper activity of the bowels by the use of milk alone. It is most unwise in such cases to resort to the use of laxatives, such as saline mineral water or other aperients. These drugs largely counteract the beneficial effects of the milk regimen and should never be employed. In fact, drugs of all kinds are detrimental.

Constipation may best be overcome by the use of substances which afford bulk without presenting to the digestive organs elements which require digestive work. Cellulose, convenient in

the form of agar-agar or bran, is the element provided by nature for this purpose. Lubrication is required in most cases in which chronic constipation has long existed, for the reason that the intestine has ceased to produce the normal quantity of lubricating mucus. Lubrication may be obtained by the use of suitable petroleum products. Refined white Russian paraffin oil will answer the purpose in most cases. Liquid petrolatum, a similar product, is claimed to be equally valuable. In some cases a heavy emulsion of paraffin oil is more acceptable to the stomach. In the writer's experience a very heavy paraffin with a melting point near that of the body, much heavier than any of the liquid oils, gives best results. This product may be had in tablet form.

Temporary Use of the Enema

In cases in which the bismuth meal has shown a much dilated cecum, the patient should take once or twice daily, at least during the first week or two, an enema consisting of two or three pints of water, the purpose being to make sure that the colon is completely emptied at least once in twenty-four hours. Cases in which the x-ray examination shows incompetency of the ileocecal valve sometimes require an extra quantity of agar-agar or bran or some combination of these two excellent forms of cellulose.

The best times for giving the enema are at bedtime and soon after breakfast. The enema should be given in two parts: First, two pints at a temperature of 102° F., and, after this has passed

off, another at a temperature of 80° F. Care should be taken to cleanse the anal region well with water after each bowel movement and to introduce a tannic acid suppository as a precaution against irritation and hemorrhoids.

Insomnia

One of the difficulties arising from confinement of the patient in bed is insomnia. The patient is sometimes kept awake by gastric or intestinal disturbances, but more frequently wakefulness is due to "nervousness" due to the irritating effect of intestinal toxins upon the brain cells. To the latter class belong cases formerly classed as cases of insomnia due to anemia of the brain. The disposition to sleeplessness usually disappears within a few days after the beginning of the fruit regimen or the milk regimen.

In cases in which this symptom is persistent, the patient should take every night at bedtime a neutral bath; that is, a full bath at a temperature of 96° to 92°. The bath may be a little warmer at the beginning for one or two minutes, then the temperature should be lowered to 96° to 92°, but never lower.

Care should be taken to make the patient comfortable in the bath by folded blankets so placed as to support the body in a comfortable position, or by means of water bags filled with water at the temperature of the bath.

The duration of the bath should be as long as necessary to produce drowsiness. In most cases the patient will fall asleep in the bath. When this stage is reached the patient should be taken

from the bath without lowering the temperature of the water and should be quickly wrapped in a large Turkish sheet, placed in bed and sent off to sleep immediately without rubbing or drying. Care should be taken to make the sheet touch the surface of the body at every point so that the skin may not be chilled by evaporation. Avoid an excess of bed covers. The quantity of covering should be just sufficient to make the patient comfortable without overheating.

In very obstinate cases the patient may be allowed to remain in the bath for an hour, or even two or three hours if the disposition to sleep is not sooner induced. Generally after a neutral bath properly given, the patient will go to sleep quickly and will sleep soundly all night. Sometimes, however, the patient will awaken after two or three hours and will be unable to sleep again. In such a case the bath may be repeated. When it is inconvenient to administer the neutral bath the neutral wet sheet pack may be given. The moist abdominal bandage is also highly serviceable.

Application of the Milk Regimen in the Treatment of Various Disorders

First of all, it is important to have a correct idea of what is to be accomplished by the milk regimen. There is no panacea for disease. The milk regimen is not a cure-all, but there are certain things which it may be relied upon to accomplish with almost mathematical certainty. Properly managed, the milk regimen will change the intestinal flora and will do it rapidly. It will re-establish the normal flora of infancy and will change the action of the pernicious bacteria with which the colon has become infested. How this is accomplished has been explained in preceding pages. Milk will not cure hay fever, as certain enthusiasts have claimed. It will not cure diabetes, and generally increases the amount of urinary sugar. It will not cure Bright's disease, though when properly managed, it often renders great service in this malady. The new "growth" of the stomach, liver, intestine, pancreas and other viscera, which some empirical advocates of the milk cure claim to have observed, does not materialize. The deposit of fat in and around the viscera may increase their volume but no actual growth of gland tissue can be expected.

Milk is not a stimulant as has been claimed. Stimulation is not helpful but harmful. Observing physicians long ago recognized the fact that

the significance of stimulation is not an increase of strength or energy but a wasteful expenditure of energy; in other words, stimulation lessens a man's store of energy instead of increasing it. Milk improves nutrition by changing the intestinal flora and supplying a rich variety of useful vitamines together with useful phosphates and lime and a large amount of easily assimilable iron. The chief benefit derived from the milk regimen is the delivery of the body from the great labor of dealing with a constant flood of poisons pouring into the blood from the intestinal canal.

The milk regimen may render useful service in nearly all forms of chronic disease; but as previously remarked, it is not a panacea. It should by no means be regarded as competent to displace all other therapeutic measures, although in certain forms of chronic disease its effects are so remarkable that it seems to be almost sufficient to constitute a whole therapeutic system by itself. This is particularly true of cases of emaciation accompanied by intense intestinal toxemia. In these cases, the emaciation is not infrequently due to the profound disturbance of metabolism produced by the poisons absorbed from the colon.

These patients are not infrequently found suffering from the effects of excessive meat feeding. Under the erroneous belief that meat is the article of food which is best adapted to tissue building and to the reinforcement of enfeebled bodily energies, and not infrequently under the advice of some physician who unfortu-

nately entertains the same mistaken notion, patients have eaten large quantities of meat, sometimes to the exclusion of other foodstuffs, and with the result that a condition of most profound intestinal toxemia has been induced with the usual consequence of universal disturbance of the bodily functions, headaches, insomnia, neurasthenia, loss of appetite, despondency and general enfeeblement of mind and body with more or less emaciation. It is no wonder that the patient's tongue is coated, his breath foul, his skin sallow, and if he has reached middle age, he is very likely to show very marked indications of premature senility.

In such cases the milk regimen, preceded for a few days by the fruit regimen, usually produces an immediate and often really marvelous change. The stools soon lose their fetid and loathsome character, the tongue clears, the breath becomes sweet, the skin loses its dingy aspect and acquires the lively tint of health, the wrinkles disappear as the face and figure are rounded out by a layer of fat, and the patient experiences a sense of well-being, of vigor and vitality such as it is difficult to describe in words, and the mental change for the better is fully equal to the physical improvement.

Unfounded Prejudice Against Carbohydrates

A vast multitude of invalids and semi-invalids have suffered great damage through an undue fear of injury from the use of starchy foods. Many physicians as well as patients have entertained the idea that a farinaceous diet may give rise to acidosis, rheumatism, and a long train of ills. Nothing could be more contrary to the truth. Starch is of all the food principles the one least likely to become a source of disease or injury. Starch is of all foodstuffs the most easily digestible, the most easily assimilable, and the most easily and completely oxidized or burned in the body. The products of its combustion are simply water and carbon dioxide, a gas. The carbon dioxide escapes through the lungs with the greatest facility.

Starch is converted into sugar in the process of digestion, and thus becomes the chief fuel element of the body. Every heart beat, every muscular movement, is possible only through the consumption of sugar. An excess of starch not needed for immediate use is readily convertible into fat and stored for future use. Starch even enters into the composition of growing muscles and other organs.

The views held by some of the older medical writers respecting the possible injury from a diet containing much starch have been shown by authoritative physiologic researches to be wholly unfounded.

A Permanent Change of Habits Required

An important thing that must never be forgotten is to give the patient such instructions at the conclusion of his course of treatment as will enable him to maintain the improvement which he has secured. In general, the improvement derived from the milk regimen is only the preliminary step toward far greater improvement which may be experienced by a consistent following of the proper regimen.

The usual practice of those who have employed the methods of milk cure heretofore in vogue, has been to instruct the patient to return more or less rapidly to his customary mode of life; indeed, it has been supposed that the proper test for the efficiency of milk feeding as a therapeutic measure was the ability of the patient to return without discomfort to his old diet and his old habits. This is a most serious error.

Every person suffering from chronic disease, or at least every person who is likely to be benefited by a milk regimen, is afflicted because of some faulty habit or habits, which operating through long years, like the wearing away of a granite rock by the continued dripping of water, has finally broken down the defensive powers of the body and caused such a derangement of bodily functions as is incompatible with health and comfort. The milk regimen is beneficial because it affords a ready means, a short cut, so to speak, by which the patient can get back into approximately normal conditions.

Milk is the simplest of all foods; the first food that the body receives when it begins its

independent existence, and affords such a complete and rich assortment of materials adapted to the nourishing and rebuilding of the body, that the conditions requisite for normal nutrition are quickly secured. And further than this, the "milk regimen" eliminates from the alimentary canal the wild bacteria, the harmful flora, which through wrong dietetic habits and other digressions have taken possession of the colon, often of the whole alimentary tract, and have established a veritable Pandora's box of ills and miseries that one by one unfold through years of misery and suffering and premature decay.

Common sense certainly suggests that when a person has once been delivered from this unhappy situation he ought to take care that he does not again fall into the same slough. Instead of returning to his vicious habits of eating, drinking and various other departures from the biologic way of life, he should earnestly seek by every means in his power to conform to the requirements of biologic law. Hence, when the "milk regimen" is terminated, the patient should by no means return to his former bill-of-fare, but should adopt a natural or biologic regimen, not as a temporary expedient but as a permanent practice to be followed for the balance of his life.

It is of the utmost importance that every person who has suffered from a chronic disorder should understand that he can never be cured in the sense of restoration to complete physical soundness. A chronic disease in this respect differs from an acute disease. An acute disease

is like a sudden blaze breaking out within a house, such as might occur from the upsetting of an alcohol lamp. It is a fire *in* the house, but not *of* the house. The fire may go out from exhaustion of the combustible material or it may easily be put out by the application of the proper means and the house may remain intact or be only very slightly damaged. But in chronic disease the situation is different. The condition is analogous to that in which a fire starting in the basement has worked its way up through walls and partitions until it has reached the top of the edifice, finally breaking out through the roof and the attic windows. In chronic disease the house itself is injured, in a sense irreparably damaged. The kidney, if the seat of chronic disease, is in part destroyed. The disease may be arrested but the destroyed tissues cannot be reproduced. The same principle applies to every organ that is the seat of chronic disease. The best that remedies of any kind can do is to arrest the disease, to stop its further progress and to take such care of the "things that remain," that they may suffer no further injury.

The body is able in some instances to create compensating devices that greatly mitigate the evils resulting from losses sustained by disease, but in no case can the chronically diseased body be restored to original soundness. The reserve vigor or margin of safety with which the intact body is endowed, having once been lost, can never be regained; consequently, the person who has been relieved of the distressing symptoms and embarrassing inconvenience of a chronic malady

by some specific regimen or other physiologic measure, must not for a moment imagine that he can with impunity return to his old ways. He must continue to do penance for his wrong doing for the balance of his life. If he desires to prolong his life and promote his efficiency to the greatest extent possible, he must go farther and "do works of supererogation" most industriously and perseveringly.

The Milk Regimen in Gastric and Intestinal Disorders

Karell was perhaps the first to observe that by means of the milk regimen it was possible to completely control the conditions of the alimentary tract. It is safe to say in general that by a combination of the fruit regimen and the milk regimen as recommended in this work, nearly all forms of chronic functional disorders of the stomach and intestine may be readily mastered. That this is not an extravagant claim will be readily conceded when the rationale of the therapeutic application of the "milk regimen" to these various morbid conditions is clearly understood.

The Milk Regimen in Hyperhydrochloria

The milk regimen lends itself most admirably to the relief of gastric hyperacidity. This condition was formerly supposed to be due to abnormal fermentations in the stomach and the development of lactic acid through the fermentation of starch or sugar. This erroneous view

was based upon the observation that persons suffering from hyperacidity generally experience an aggravation of their symptoms when placed upon a farinaceous diet.

The discoveries of Pavlov made clear the reason for this. Pavlov showed that a diet consisting largely of flesh foods, and particularly a diet rich in the extractives of meat, such as soup, bouillon, etc., caused the stomach to pour out a highly acid secretion closely resembling that produced by the stomach of the dog. A farinaceous diet, on the other hand, produces a gastric juice having a very low degree of acidity.

The reason for this is simple. Flesh food, consisting of albuminous matter, requires a highly acid gastric juice for its digestion; at the same time, the protein present readily enters into combination with the acid, thus neutralizing it so that although the amount of free hydrochloric acid produced is large the amount of *free* acid in the stomach is very small. When farinaceous food is introduced into a stomach that has been accustomed to a flesh diet it encounters a gastric juice very rich in hydrochloric acid; the amount of protein present to neutralize this acid is small and consequently a large amount of hydrochloric acid remains free or uncombined and not only acts as an irritant upon the gastric mucous membrane but disturbs the action of the pylorus.

The pylorus readily opens under the influence of the free hydrochloric acid of the gastric juice in contact with its gastric side, but when the highly acid contents of the stomach have passed through the pylorus and reached the duodenum,

a powerful reflex action is set up which not only closes the pylorus, but induces a state of spasm in the muscle, pyloric spasm or cramp. To this fact is chiefly due many of the symptoms and morbid conditions which are associated with an excess of gastric acid.

Fermentation in the stomach rarely occurs except in cases of great obstruction at the pylorus, due to spasm or stricture from ulcer or cancer. When foodstuffs are very long maintained in the stomach, fermentation and even putrefaction may take place. Cases of this sort are comparatively rare. The acid which gives rise to "heartburn," acidity, eructations and gastric pain frequently associated with ulcer of the stomach or duodenum, is not due to fermentation, but is the result of an excessive secretion of hydrochloric acid.

This great excess of acid is not infrequently accompanied by a deficiency of pepsin. The pepsin seems to be destroyed by the hydrochloric acid of the gastric juice when it is present in very excessive quantity. In a case recently under the writer's observation, the patient's gastric juice contained three times the normal amount of acid and only one-sixteenth of the normal proportion of pepsin. Digestive tests showed the stomach to be doing little or no digestive work, notwithstanding the large amount of gastric acid secreted. The injury resulting from an excess of gastric acid may be far greater than that resulting from a moderate degree of deficiency in free hydrochloric acid in the gastric juice because of the irritation pro-

duced by the excess of acid not only in the stomach but also in the upper part of the small intestine.

Farinaceous foods, then, are not the cause of the acid; they simply become the occasion for the condition of the stomach to reveal itself; that is, they permit the fact that the gastric secretion contains an excessive amount of gastric acid to become apparent, whereas the condition is concealed when a flesh diet or a diet rich in protein is taken. Meat neutralizes the acid by combining with it, but at the same time excites the gastric glands to produce continually an increasing amount of acid. As already stated, milk lends itself in the most admirable manner to the correction of this condition, and in several ways.

1. Milk contains a considerable proportion of fat, which, according to Pavlov's observations, inhibits or diminishes the secretion of acid by the gastric glands. The amount of acid present in the gastric juice was found to be less when the diet consisted exclusively of milk than on any other diet, while a meat diet produced the highest degree of acidity. The usual amount of milk taken by a patient on the milk regimen is twelve pints. The milk contains from four to five per cent of fat. A patient given this amount of milk would take nearly half a pound of fat a day. The frequent intervals at which the milk is given keeps the mucous membrane of the stomach constantly under the influence of this acid-restraining fat.

2. Milk contains a large amount of lime—

eleven to sixteen grains per pint. Lime readily enters into combination with hydrochloric acid, neutralizing it and acting in this respect precisely as does soda. The amount of lime present in two quarts of milk is sufficient to neutralize the total amount of acid ordinarily secreted by the stomach in twenty-four hours. It is probably true that in cases of hyperhydrochloria an excessive amount of acid is formed, but it seems equally probable that the lime contained in six quarts of milk, three times the quantity necessary to neutralize the amount of acid ordinarily produced, should be sufficient to neutralize any amount of acid likely to be present, or, at least, to reduce it to normal proportions.

3. The protein of milk is also capable of entering into combination with the gastric acid, just as does the protein of meat, and so protecting the gastric mucous membrane and correcting the disorders due to an excessive amount of free or uncombined acid. The protein of milk combines with hydrochloric acid in the proportion of about five parts of casein to one of hydrochloric acid. A simple calculation shows that there is a sufficient amount of protein in six quarts of milk to neutralize an ounce and a half of hydrochloric acid, or three times the amount ordinarily produced in the stomach.

4. Milk is normally digested in the small intestine rather than in the stomach. Hence, when taken in a proper manner, it is quickly passed out of the stomach into the intestine so that little digestive work is required of the stomach, and this organ, when the seat of gastritis or

chronic ulcer or other conditions accompanied by congestion or irritation, is placed in a favorable condition for repair.

Clinical experience shows the milk regimen to be a very highly efficient means of combating one of the most common of all forms of gastric disturbance, a condition of hyperhydrochloria, or hyperacidity. It is important to note, however, that in order to secure good results the plan of administering the milk elsewhere described in this work must be rigidly adhered to. When milk is taken with other foods it is very likely to produce digestive disturbances of various sorts. The reason for this is quite obvious, when the physiology of digestion is kept in mind.

The first step in the process of digesting milk is coagulation of the casein, that is, milk is converted into curds in the stomach. If these curds are large, tough and hard they will be digested only with much difficulty and a considerable portion will find its way to the colon where it will be likely to be delayed by adhesions of the pelvic colon or other impediments and undergoing putrefaction will give rise to a high degree of intestinal toxemia. When a small quantity of milk is taken into a stomach in which there is present a considerable quantity of strongly acid gastric juice, the result will be formation of large, tough curds; whereas if a larger quantity of milk is taken, especially when other foods are practically excluded, the casein forms small and soft curds which if properly digested pass so rapidly through the colon that no time is afforded for putrefactive changes to take place.

When milk is taken with other foods, many of which require a very active gastric juice containing a large amount of hydrochloric acid, the proportion of the milk taken being very small in proportion to the amount of hydrochloric acid in the stomach, large and tough curds are formed which interfere with the digestive processes and encourage putrefaction in the colon.

In cases of hyperhydrochloria it is well to give twenty to thirty grains of bicarbonate of soda half an hour after each feeding and to repeat the dose if necessary an hour or two later. When this is not sufficient a dessert spoonful of olive oil may be given with each feeding or at every other feeding as the case may require.

The tendency to hyperacidity sometimes disappears within a week or ten days, so the patients who have not been able to tolerate fruit acids for years find themselves able to eat fruit easily without any inconvenience.

Not infrequently patients, especially those who are thin in flesh, are advised to take a glass or two of milk midway between meals. According to the writer's experience, the majority of persons who try the experiment of taking milk in this way experience very unpleasant effects. Two and one-half or three hours after a meal the acidity of the gastric contents is at its greatest height. Milk entering the stomach under such conditions is certain to give rise to formation of very large tough curds. The result may be an aggravation of all the patient's symptoms through the gastric irritation induced.

It is evident, then, that milk as a food is es-

pecially adapted to the treatment of cases of gastric acidity or hyperhydrochloria. Taken at frequent intervals, the activity of the acid-secreting glands of the stomach will be greatly lessened. The stomach and alimentary canal will be constantly bathed with soft non-irritating curds which by filling the intestine will stimulate peristaltic activity and thus overcome the stasis of the small intestine as well as of the large intestine, thus removing what the writer believes to be one of the most potent of all the causes of hyperacidity, viz.: intestinal stasis and resulting toxemia.

The rationale of the curative action of the milk regimen in cases of hyperhydrochloria is highly interesting. One of the functions of the stomach, as shown by Rogers and others, is to excrete poisons from the blood so as to keep them out of the circulation until the liver can have time to distoxicate them and the kidneys to eliminate them. When morphia is injected under the skin one-half of the whole amount may be found in the stomach within thirty minutes.

Of course, the morphia is reabsorbed after it reaches the small intestine, but it enters the portal vein and so is carried to the liver where it is acted upon by the liver cells and to a large degree deprived of its toxicity. Apparently the same thing happens in relation to ammonia and other products of putrefaction when produced in the colon in such large quantities that they get into the general circulation as they may easily do through the connection of the portal

circulation at several points with the systemic vessels. The presence of ammonia in the stomach stimulates the gastric glands to make an excess of acid, an effect produced by small quantities of soda and other alkalies. Evidence of the presence of ammonia in the stomach in cases of hyperhydrochloria is afforded by the large amount of neutral combined chlorine found in these cases. Hayem and Winter showed that the neutral combined chlorine is a compound of hydrochloric acid and ammonia.

Agreeable to this view is the fact that persons suffering from hyperhydrochloria are practically always constipated. Taylor* calls attention to animal experiments which indicate that "increased bacterial action in the intestine . . . provokes in some way an increased secretion of hydrochloric acid in the stomach."

The following case is a fair illustration of the results usually attainable in the milk regimen in cases of hyperhydrochloria.

The patient, a woman aged 40, had for several years suffered from the typical symptoms of hyperhydrochloria for relief of which she came to the institution for treatment. Examination of the stomach fluid after an Ewald meal showed a high percentage of free hydrochloric acid and of neutral combined chlorine. After two weeks of the milk regimen the distressing symptoms due to the excess of acid had wholly disappeared and the free hydrochloric acid was normal while the neutral combined chlorine was reduced from

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* "Digestion and Metabolism," p. 137.

an excess of 240 per cent to an excess of 80 per cent, showing an enormous reduction in the amount of ammonia produced. The following table shows the percentages of the different forms of chlorine found before and after treatment and the relation to the normal:

	Normal	Before Treatment	After Treatment
Free HCl.....	.080-.110	.136	.078
Acid Combined ..	.045	.044	.036
Neutral Combined	.020	.068	.036

A study of some hundreds of cases affords evidence that the amount of neutral chlorine in the stomach may be regarded as to some degree a measure of the amount of intestinal putrefaction present in a given case.

The Milk Regimen in Achylia

When the gastric glands have been long overstimulated and made to produce an excessive amount of hydrochloric acid and pepsin, and especially when gastritis has existed for a long time, the glands undergo degeneration and a condition is finally reached in which hydrochloric acid and pepsin are no longer produced, or are produced in such small quantities as to be of no practical use in digestion.

In the absence of hydrochloric acid, the normal disinfectant of the stomach, numerous species of bacteria, molds and other micro-organisms colonize upon the walls of the stomach, and as the natural result the alimentary canal becomes infested with numerous species of bacteria, many

of which are unable to find entrance to the intestine so long as the gastric juice is present in the stomach in normal amount. Here the milk regimen proves itself a valuable remedy because of the antagonism which exists between the fermentation and putrefactive processes.

In achylia the pylorus remains constantly open. In the absence of free hydrochloric acid the reflex mechanism by which the pylorus is opened and closed is inoperative; consequently, the milk readily passes from the stomach into the small intestine and the patient is not likely to suffer from nausea, vomiting, or other symptoms which sometimes develop at the beginning of treatment in cases of hyperhydrochloria.

It is thus evident that milk is capable of rendering excellent service as a disinfectant of the stomach. In order to increase its efficiency in dislodging from the stomach the parasitic micro-organisms with which it is infested, it is well to administer the milk in the form of buttermilk, or at least to add to the fresh milk an equal quantity of buttermilk. Buttermilk prepared with the Bulgarian ferment is much to be preferred for this purpose to ordinary buttermilk on account of the fact that it grows more vigorously and produces four times as much acid. This is evident when it is remembered that the presence of lactic acid is a condition essential for destroying the parasitic growths which infest the stomach in the condition of achylia. The lactic acid seems in this respect to act, to some degree at least, as a substitute for the normal hydrochloric acid.

The Milk Regimen in Gastritis and Enteritis

In acute gastritis and enteritis the stomach and intestine require absolute rest. The water diet, also called "absolute diet" by the French, is best suited to these conditions. The normal digestive fluids are not present and the taking of food can do nothing more than to increase the irritability present. In chronic gastritis and enteritis, so-called gastro-intestinal catarrh, the condition is wholly different. This condition is not a true inflammation, but a chronic infection. There is no condition in which a change of flora is more urgently called for, and for this purpose no better means is offered than the milk regimen. By passing through the stomach and intestine a continuous stream of milk, or better, a mixture of milk and yogurt buttermilk, the diseased surfaces are continually bathed with a bland soothing liquid, which, by its acidity, stops the growth of the parasitic infesting bacteria. This gives the diseased parts an opportunity to gain the ascendency in the struggle against the invading organisms and the result is in many cases a remarkably rapid return to normal conditions.

The Milk Regimen in Colitis

Nearly thirty-five years ago the writer became acquainted with the value of kumyss in the treatment of gastro-intestinal affections. Not liking the idea of administering an alcoholic beverage (kumyss often contains as much alcohol as beer),

the writer some thirty years ago began experimenting for the purpose of finding a method of producing a non-alcoholic substitute for kumyss. All the various lactic-acid organisms then known were studied and two which produced no alcohol and little or no formic acid were selected. Sour milk preparations made with these ferments were rendered effervescent by charging with carbonic acid gas and so a very satisfactory substitute for kumyss was produced. This preparation (kumyzoon) was largely used for a number of years at various medical institutions with most excellent results. The advent of the *B. Bulgaricus* some years later led to the substitution of yoghourt buttermilk on account of its greater convenience and perhaps greater efficiency.

Constantly bathed with the bland antiseptic milk or buttermilk, the inflamed gastric and intestinal mucous membrane is placed in a condition highly favorable for improvement. Of course degenerated glands may not be reproduced, but great and rapid improvement may be expected in most cases in which malignant degeneration has not occurred.

Hayem and Winter of Paris showed the great value of buttermilk in the treatment of gastric catarrh more than twenty years ago.

In highly spastic conditions of the rectum due to proctitis of the pelvic or descending colon, colitis, subnitrate of bismuth may be advantageously employed. A five per cent preparation of bismuth is used, the vehicle being a paraffin preparation which melts at the tempera-

ture of the body (Beck's paste). The patient is placed in the knee chest position, a proctoscope is introduced, and a rectal tube is passed as far into the pelvic colon as possible. The proctoscope is withdrawn and the paste is passed in through the tube by means of a piston syringe. These applications may be made daily or every other day as the severity of the case may require. Fresh cultures of *B. Bulgaricus* and *B. bifidus* in whey are found of great service.

The writer's first observations of the beneficial effects of sour milk in infections of the colon were made some fifteen or sixteen years ago, soon after the announcement of the discoveries of Tissier and Metchnikoff in relation to the controlling influence of acid-forming organisms upon the growth of putrefactive and pathogenic organisms. The interesting facts brought forward by the French savants, suggested the idea of employing enemas of buttermilk as a means of combating colitis. The results obtained were highly satisfactory, sometimes, in fact, improvement was so rapid as to seem almost miraculous. This method has been employed in some thousands of cases, although now for several years a pure culture in whey of the *B. Bulgaricus,* the *B. bifidus,* and other beneficent organisms has been employed.

By flushing the colon with an active culture of acid-forming organisms combined with a small amount of well boiled starch and malt sugar or lactose to furnish food for the acid-forming micro-organisms, infections of the colon are in most cases rapidly overcome.

In using the culture proceed as follows: Prepare a very thin starch solution by boiling a teaspoonful of corn starch in a pint of water. Cool to 140° F., then add 4 ounces of culture and half an ounce of milk sugar or malt sugar. Put the patient in the knee chest position and slowly introduce the warm mixture. The patient retains the knee chest position for five minutes and takes deep breaths to assist the movement of fluid along the colon. The colon is well cleansed by enema before the culture is given.

In the writer's experience, there is no means by which intestinal infections may be so quickly overcome as by flushing with cultures of the *B. Bulgaricus* and *B. bifidus* in connection with the milk or fruit regimen.

Whey Cultures

The best culture medium for the *B. Bulgaricus* is whey prepared by the addition of rennet to skimmed milk. After the whey is separated, it should be sterilized and tnen inoculated with active cultures of the *B. Bulgaricus.* After inoculating, the whey should be kept at a temperature of about 100° for three to five days, according to the season of the year, or until slightly acid. It is then ready for use.

The *B. bifidus* must be prepared in a separate peptone culture by a bacteriologist and added just before using.

When whey can not be obtained proceed as follows: to one quart of skimmed milk add three quarts of water and four ounces of milk

sugar. Boil for fifteen minutes. Allow to cool to one hundred degrees, then add a half pint of yoghourt buttermilk or a dozen yoghourt tablets, or two or three ounces of a liquid culture of the *B. Bulgaricus.* Allow to stand at a temperature of 100 degrees until slightly acid. Strain.

In the preparation of cultures to be used in changing the intestinal flora, great care must be taken to avoid contamination with yeast. The lactose present provides good nutrient material for the yeast cell and so will encourage the rapid development of the alcoholic fermentation with a great abundance of gas and resulting distension of the intestines.

The Milk Regimen in Gastric and Duodenal Ulcer

These conditions are usually associated with gastric hyperacidity and hence are naturally amenable to the same therapeutic measures which yield success in the treatment of hyperhydrochloria. The method employed is not materially different. It is necessary, however, in some cases in which there is great irritability and considerable pain after eating, to protect the sensitive surfaces by liberal doses of bicarbonate of soda which may be given with the milk or just before the milk is taken.

In extreme cases, it is best to begin with very small doses and the milk should be taken cold. The first day half an ounce of milk may be given every hour; the second day, if all goes well, the quantity may be doubled; the third day, four ounces may be taken, and on the fourth day four ounces may be taken every

half hour. If the milk is found to be well tolerated, the quantity may be further increased on the fifth day and by the end of the week the patient may be taking the full milk ration. Liberal doses of heavy paraffin oil should be administered and, if necessary to insure free bowel action, as is usually the case, agar-agar should be given or agar-bran.

It is scarcely necessary to say that in the treatment of cases of gastric and duodenal ulcer, gastritis and hyperhydrochloria it is necessary to avoid highly acid fruits. Banana purée, purées of pears and sweet apples are the best fruits for use in these cases. Stewed raisins and Malaga grapes are generally well tolerated. After the cure is fairly well advanced—that is, after a couple of weeks—it is generally possible to employ sub-acid fruits, such as sweet oranges, apricots and purées of sweet prunes.

The Milk Regimen in Anemia and Chlorosis

The milk regimen succeeds admirably in this class of cases as would naturally be expected since this regimen furnishes in abundance exactly the things which are needful in anemia and chlorosis. It is true the amount of iron contained in milk is small, only about three milligrams (1-20 grain) to the quart, but since an adult man only requires about ten to twelve milligrams (1-6 to 1/5 grs.) of food iron daily it is evident that six quarts of milk will furnish to the body a large surplus of food iron; and a fact of great importance in this

connection is the interesting observation of Von Wendt, who noted that the presence of ample quantities of lime greatly facilitates the assimilation of iron.

Sherman has also called attention to the fact that the iron furnished in milk is of a remarkably choice quality and exactly adapted to the needs of the body. For instance, experiments have shown that the iron of hemoglobin, the form in which iron occurs in blood and in flesh, is only in part assimilated. In the words of Sherman, "It seems to be established that hemoglobin and hematin may be absorbed and assimilated to some extent but probably not to such good advantage as the iron compounds of eggs, milk and vegetable foods."

It is to be especially noted then that milk contains a choice and ample supply of iron and a large amount of lime (eleven to sixteen grains to the pint) to promote the assimilation of the iron. Besides, milk is rich in vitamines, the importance of which as hormones which activate or set in operation the processes essential to good nutrition has been abundantly demonstrated by Funk and others.

The free use of bran in connection with the milk regimen adds to its value in blood building.

In grains the principal part of the iron is found in the outer covering which is removed in connection with the bran. Flour prepared from the entire grain contains more than three and one-half times as much iron as does fine flour. Since the bran constitutes about twenty per cent of the entire weight of the grain it

appears that the bran, one-fifth of the grain, contains four-fifths of the iron; in other words, while fine flour contains one and one-fifth milligrams of iron in a hundred grams of flour, one hundred grams of bran contain twenty milligrams or more than thirteen times as much. In taking two ounces of sterilized bran, the usual amount given daily in connection with the milk regimen, a person will receive twelve milligrams of iron, which added to the eighteen milligrams taken in the milk, will furnish to the blood thirty milligrams of iron or about three times the amount of food iron ordinarily required.

It is evident, then, that as a source of iron the milk regimen is amply sufficient. But it remains to be added that a considerable amount of iron is also supplied by the lettuce, celery and fruit, liberal quantities of which are included in the regimen. These contain a considerable quantity of iron. It is also permissible to allow purées of spinach and other greens as well as various fruits which are rich in iron. Raisins and prunes, for example, furnish on an average about one milligram of iron for each ounce of raw material, and lettuce contains one and one-half milligrams of iron to the ounce of fresh substance; whereas lean beef contains only two-thirds as much iron and ham only one-fifth as much. Compared with such fat meats as bacon, lettuce furnishes twenty-five times more iron, while spinach contains four milligrams to the ounce or more than four times as much iron as the best beef, and iron of a sort which is most

easily assimilated and utilized, which is not true of the iron of meat.

Dried figs contain the same amount of iron found in beef, while hazelnuts are richer in iron than beef, and lentils offer more than twice as much iron as the best beef.

Another point of very great significance that must not be overlooked is the influence of milk in suppressing intestinal putrefactions. Herter and others have shown that both chlorosis and the more intractable forms of anemia are associated with intestinal putrefactions. Von Noorden, Ewald and others have long noted the importance of suppressing intestinal putrefactions in the treatment of these various disorders.

Numerous eminent authorities have maintained that a common cause of anemia is the production in the intestine of poisons which when absorbed destroy the red blood cells.

For more than forty years the writer has employed an antitoxic diet as the most efficient means of dealing with stubborn cases of this kind, and of the various antitoxic dietaries that may be arranged, the milk regimen either alone or following or alternating with the fruit regimen, yields the best results.

The Milk Regimen in Neurasthenia, Hysteria and Hypochondriasis

A constant association of these disorders, especially neurasthenia and hypochondriasis, with intestinal toxemia, indicates at once the appropriateness of the milk regimen as a therapeutic measure.

The writer happened to be associated with the late Dr. George M. Beard as an office and dispensary assistant at the time he was perfecting the data upon which he based his grouping of morbid conditions which he called neurasthenia.

The writer was never convinced that this so-called malady was really a disease entity but has rather regarded it as a convenient name for designating certain groups of symptoms, the real cause of which may be different in different cases. The most common etiologic factor is, however, in the writer's opinion, the pernicious influence of various toxins, some known and others unknown, which are absorbed from the alimentary canal.

The typical neurasthenic has a coated tongue, a bad breath, a dingy unhealthy looking skin and very foul stools. He is invariably constipated, though very often the constipation is latent in form, the bowels moving regularly once a day or even more often. The movements, however, are belated, two or three days behind time. The colon is filled with putrefying material which in many instances may be shown by x-ray examination to be forced back into the small intestine through an incompetent

ileocecal valve by exaggerated anti-peristaltic contractions of the colon. These putrefying materials, mingling with the digesting and absorbing foodstuffs, are rapidly taken into the circulation and produce universal disturbance throughout the body.

The rapidity with which a wretched neurasthenic may often be transformed into a normally functioning, happy and useful individual by means of expert employment of the milk regimen for three or four weeks is most gratifying, and is often appreciated quite as much by the friends and relatives of the patient as by the patient himself. As soon as the patient is delivered from the perverting influence of the toxins with which his cells are flooded by the change effected in his intestinal flora through an application of the fruit regimen followed by the milk regimen, the recuperative powers of the body quickly assert themselves and normal conditions are rapidly restored.

The Milk Regimen in Obesity

The milk cure has been long employed as one method of reducing weight in obesity. It was used in cases of this sort by Karell and is generally known in Europe as the "Karell Cure." More than fifty years ago this method was employed by the famous Professor Niemeyer, who obtained his knowledge of the method from Karell, who visited his clinic at Tübingen in 1861.

In one case reported by Niemeyer, a patient

treated by the milk cure method of Karell lost 25 pounds in seven days, while under former methods of treatment he had gained two or three pounds a day.

The Karell method as commonly practiced in Europe is thus described by F. Moritz:*

The patient is given from one and one-quarter to two and one-half liters of milk daily. This small quantity of milk is given in five doses. With a milk ration of two quarts a pint of milk was given at 7:30 a. m. and a half pint at 10 a. m.; a pint at 1 p. m.; a half pint at 4 p. m.; and a pint at 7 p. m. Sour milk was allowed if preferred. If thirsty, the patient was allowed to drink water in addition to the milk or as a diluent for the milk.

According to Moritz, patients treated by this method do not suffer from thirst or hunger. The method is recommended by German physicians as being not only the best but the cheapest.

M. L. Roemheld,** another German physician, reports similar success in the treatment of obesity by a modified method in which milk was taken as an exclusive diet one or two days each week, the patient in the meantime resting in bed. The quantity of milk given was one liter, a little more than one quart. Sometimes a little fruit was allowed in addition. One effect of the milk feeding noted in these cases is the increased activity of the kidneys. This is caused

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* *Munchen Med. Wochenschr.*, 1908, LV. pp. 1569-73.

** *Munchen Med. Wochenschr.*, 1908, LV, p. 1496.

by the greatly diminished intake of chloride of sodium. The amount of urine passed is usually about twice that of the milk taken. This method is particularly successful in cases in which the obesity is associated with disease of the heart or blood vessels.

Another German physician, L. Jacobs,* recommends the following method:

The patient takes half a pint of milk four times a day, at intervals of four hours. No other liquid or solid food is permitted for five or six days. This method is especially recommended in cases in which marked cyanosis, dyspnea, hepatic hypertrophy and bronchitis exist.

In the writer's experience, the methods above suggested are not nearly so successful as the fruit regimen, or a modification of the milk regimen in which it is used in combination with fruit and a liberal allowance of such coarse and innutritious vegetable products as lettuce, celery, cucumbers, greens and bran or agar.

A method which in the writer's experience always proves successful in ordinary cases of obesity is the following:

The patient takes a liberal meal of fresh juicy fruits four times a day, such fruits as dates, raisins, prunes, figs and bananas may be sparingly used. The patient may be allowed to eat as much as he likes of apples, grapes, apricots, peaches, strawberries, oranges, melons and juicy fruits of all sorts. Celery and lettuce with a

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* *Munchen Med. Wochenschr.*, 1908, LV, pp. 839-847.

dressing of lemon juice are also freely allowed. Three hours after breakfast and three hours after dinner, the patient is permitted to take a pint of milk, which must be slowly sipped or sucked through a straw. In many cases it is better to omit the milk, at least for a few days.

At each feeding the patient should take half an ounce of sterilized bran or agar-agar and also half an ounce to an ounce of paraffin oil.

It is of the highest importance that the bowels should be made to move freely. This is especially true in cases of cardiac disease in which there is swelling of the feet or general anasarca.

In cases in which there is disturbance of the internal secretion, as in cases of dyspituitarism, it is necessary to add to the special feeding proper doses of dried pituitary gland, combined if need be with dried thyroid or adrenalin.

It is not necessary to limit the amount of water which the patient takes, provided he is not allowed to take chloride of sodium. The body necessarily eliminates a certain amount of sodium chloride (common salt) daily and in order to maintain the normal specific gravity of the blood and tissue fluids, the elimination of salt must be accompanied by a proportionate elimination of water. For each gram of salt eliminated in excess of the intake, the body must also eliminate about 120 grams of water or four ounces of water for each gram (¼ dram) of salt. This will insure the elimination of from one to two pints of water daily when no salt is taken, and very much larger quantities may be eliminated in cases in which dropsy is present.

The Milk Regimen in Cardio-vascular Disease

Arteriosclerosis with failing heart often presents to the physician a therapeutic problem of the greatest perplexity and gravity. The milk regimen affords valuable aid in these cases. A proper combination of the milk regimen and the fruit regimen affords great service in these cases.

It is of the highest importance to lessen the work of the kidneys by eliminating as fully as possible the intestinal toxins. These poisons have a depressing effect upon the heart and increase the degeneration of the blood vessels, thus adding to the work of the heart. There is also evidence that some of the toxins absorbed from the intestine raise the blood-pressure by producing contraction of the small arteries, thus causing still further embarrassment of the heart. By changing the intestinal flora and eliminating the toxins, great benefit is conferred upon the patient.

An application of the combined milk regimen and fruit regimen, such as has been recommended above for the treatment of obesity, often secures marked benefit by lessening the work required of the heart and frequently changes the whole aspect of the case within a few days.

When examination of the blood shows an excess of non-protein nitrogen with a high uric acid content from inefficient renal action, patients usually do best on the fruit regimen alone. The food intake may consist almost exclusively of fruit or fruit juices for two or three weeks

without injury and often with very great benefit. Carbohydrates in the form of malt sugar may be added to the extent of four to six ounces a day to sustain heart action, a purpose to which it is especially adapted on account of its very prompt absorption and utilization.

Under this regimen the patient's blood-pressure will usually drop twenty to thirty points within a couple of weeks and occasionally a drop of forty or fifty points may be observed. Sometimes the blood-pressure rises before the fall begins.

This is a good indication. It shows that compensation may be restored notwithstanding the fact that the case has progressed to the stage of secondary low pressure. The rise of blood-pressure while the patient is undergoing the special regimen is particularly favorable when the rise is accompanied by the disappearance of swelling from the feet and improvement in breathing with better aeration of the blood.

W. Herr* and many other German writers have reported great improvement from the systematic application of the milk cure even in cases in which degeneration of the heart muscle had reached quite an advanced stage. It is generally noted, in fact, that this method is more successful in cases of circulatory disturbance due to myocarditis than in cases in which obstruction to the circulation exists as the result of valvular disease of the heart.

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* *Prkt. Arzt. Wetzlar,* 1906, XLVI, pp. 225-30.

The Milk Regimen in Bright's Disease

Bright's disease is no longer regarded as a purely local affection but as a local expression of a general disorder. Although there is much divergence of views as to the nature of the pathogenic processes in operation, it is generally conceded that there is a very pronounced disturbance of the balance between acids and bases with an increase of acids. This condition calls for a regimen that will lighten the work of the kidneys by suppressing intestinal putrefactions and that at the same time will tend to increase the alkalinity of the body fluids.

The combined fruit and milk regimen accomplishes this purpose in a most admirable manner. When the patient's tongue becomes clean, the breath sweet, and the stools free from putrescent ammoniacal odors, the high blood-pressure and anasarca, if present, and other embarrassing symptoms due to renal disease, rapidly disappear. Under this regimen the non-protein nitrogen of the blood and uric acid content may even return to the normal, the albumen and casts of the urine diminish and finally disappear. The indican and indolacetic acid are reduced to extremely small quantities or may disappear entirely. In not a few instances patients who have become helpless, regain such a degree of health that with good care they are able to enjoy several years of active and useful life.

The Milk Regimen in Organic Disease of the Liver

Dujardin-Beaumetz more than thirty years ago called attention to the importance of suppressing intestinal toxins in all forms of hepatic disease, especially in cases of organic disease of the liver. A degenerated liver is a crippled liver. Such a liver has to a large degree lost its power to destroy toxins. Even in cases in which grave organic changes may not be recognizable, a state which the French call hepatism or hepatic inadequacy, may exist. The result of this imperfect functioning of the liver is the loss of one of the most important of the body defenses. The toxins absorbed from the intestine, instead of being destroyed by the liver, pass directly into the circulation, and thus the mischiefs which usually follow the absorption of the products of putrefaction from the intestine are very greatly aggravated. Disease of the kidneys, degeneration of the glands of internal secretion, hardening of the arteries and various other degenerative changes must necessarily result unless special precautionary measures are taken. Of first importance among measures of this kind are such as will lessen the activity of putrefactive micro-organisms in the intestine. This requires, first of all, change of the intestinal flora, and there is no means by which this can be so readily accomplished as by the employment of the fruit regimen, followed, if need be, by the milk regimen.

The milk regimen is especially indicated in cases in which the patient is considerably emaciated and in cases in which there is an impoverished condition of the blood and a lack of lime salts in the saliva. Great care must be used in these cases to have the bowels very active when the milk regimen is begun and to keep the bowels moving four or five times a day.

The Milk Regimen in Dropsy

The employment of milk as an exclusive diet in the treatment of dropsy is a method that at various times has had great vogue but for some years has apparently fallen into neglect, probably because of the uncertainty of results and the occasional observation of bad effects.

The modifications of the method of milk feeding presented in this work will be found to overcome the various disadvantages of ordinary milk feeding. The chief of these modifications are the addition of a liberal amount of fruit and the employment of simple but efficient measures for securing free activity of the bowels. The old method of milk feeding was practically certain to be accompanied by constipation, to overcome which, saline laxatives or other aperients, often even purgatives, were used. These drugs simply increase the work of the already crippled and overworked kidneys, whereas increased intestinal activity secured by the purely physiologic means suggested, namely, cellulose in the form of bran or agar-agar and paraffin oil in some form, at once relieves the kidneys of an enor-

mous load and without in the smallest degree adding to the work of these over-burdened organs. The milk feeding method seems to have been first employed in dropsy by Dr. Chretian,* of Montpellier, France, who published in 1831 an account of his method together with the histories of a number of cases which he had treated.

D'Alais,** a disciple of Chretian, reported sixty cases of dropsy treated by milk feeding, and with phenomenal success. D'Alais administered milk three times a day, and very curiously, advised the use of a raw onion after each dose of milk. The onion doubtless rendered real service by promoting bowel action at the same time supplying a very choice and easily assimilable form of iron (Sherman).

Later, numerous French physicians reported remarkable success in the treatment of dropsies due to various causes, by milk feeding.

The general method to be pursued in the treatment of dropsy is the same as that already outlined for cases of obesity and cardiac disease. The most successful cases are those in which the kidneys are still able to do fairly efficient work. Good results and a considerable degree of permanency in the improvement secured may be expected in cases in which the non-protein nitrogen or the uric acid content of the blood returns to normal during the treatment by the combined milk and fruit regimen.

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* *Archives Generales de Medecine,* tom xxvii, pp. 329, 349, 484 and 494.

** *Bulletin General de Therapeutique,* tom. xiv, p. 30.

The Milk Regimen in Tuberculosis

In tuberculosis, one of the grave conditions that the physician is called upon to combat is the marked tendency to emaciation. This is the natural result of the toxic fever from which the patient suffers and the absence of appetite which commonly exists.

According to the writer's experience, careful inquiry will almost invariably show in these cases very obstinate chronic constipation and many evidences of intestinal toxemia. The tongue is usually coated and the skin more or less pigmented and the urine is loaded with putrefaction products.

It is highly probable that the vulnerability of the organism to the tubercle germ is in many cases the result of the lowered vital resistance produced by chronic intestinal toxemia. When the disease has once obtained a foothold and the kidneys are required to bear an onerous burden in the elimination of the toxins produced by the tubercle bacillus, it is certainly highly important that the kidneys should be relieved of all unnecessary burdens and that the tax on the vital organs should be made as light as possible. To accomplish this, nothing is more important than a change of the intestinal flora. With the diet ordinarily recommended for patients suffering with tuberculosis, this is impossible.

Somehow the idea became current many years ago that the consumptive required for his upbuilding a large amount of protein. Some specialists in the treatment of pulmonary cases

advocated a protein intake of 600 to 1,000 calories, from one-fourth to one-third of the entire food intake. For many years high protein feeding was practically universal in sanatoria devoted to the treatment of tuberculous patients. In very recent years, especially since the famous researches of Chittenden, which were undertaken for the purpose of determining the real protein requirement, there has been a tendency toward a diminution of the protein intake; but it is still maintained by most authorities that the liberal use of meat is advantageous, if not essential, in the treatment of tuberculosis cases. In a paper read by the writer before the International Congress on Tuberculosis, held at Washington, in February 1910, this view was combated. Among the objections to free meat feeding then presented are the following:

1. A meat diet encourages intestinal putrefaction which adds greatly to the burden of the kidneys.

2. Meat contains a considerable amount of uric acid (14 grains to the pound), together with other extractives which have no nutritive value and impose extra work upon the kidneys for their elimination.

3. When meat enters largely into the dietary only a small amount of the protein intake can be utilized, as shown by Folin and others. The larger part of the superfluous protein must be treated as mere waste matter and eliminated as urea, thus increasing the work of the kidneys three or four fold. This mistreatment of the kidney is particularly likely to lead to disaster,

for the kidney is, next to the lungs, one of the most susceptible of all the organs of the body to tubercular disease. Post-mortem examinations systematically made at the Phipps' Institute have shown that in 86 per cent of all cases that succumb to tuberculosis the kidneys are diseased. It was noted in particular that the diseased condition of the kidneys was in many cases not due to infection with the tubercle germ, but was rather due to the toxic effect of the highly virulent tuberculine and other toxins produced by the tubercle bacillus and carried to the kidney for elimination.

All physicians who have had much to do with the treatment of tuberculosis have noted the frequency with which patients who have apparently recovered from the disease die a few years later from Bright's disease. It has been noted also that dogs when rendered strongly immune against tuberculosis by the injection of tuberculine very often die of degeneration of the kidneys (Brown). Every intelligent physician when consulted by a patient suffering from Bright's disease thinks it judicious to instruct the patient to protect his kidneys by such a regulation of his diet and habits as will impose as little labor as possible upon the crippled organs. To this end he not only forbids the use of tobacco, tea and coffee, but also excludes flesh meats very largely, if not entirely, from the dietary.

In view of the facts above stated, it is evident that every case of pulmonary tuberculosis should be regarded as a case of potential Bright's disease, and it can not be disputed that the patient's

health interests will be best conserved by advising him to adopt a dietary which will reduce the work of the kidneys to a minimum. A quantity of water that will only to some degree check or control an active conflagration might have easily extinguished the fire entirely soon after it started. The same principle applies in this case. A regimen that is necessary to prolong a patient's life when he has Bright's disease, or to postpone a funeral for a short time, if applied earlier might have prevented the development of the Bright's disease and so postponed the funeral indefinitely.

The first advantage derived from the milk regimen in tuberculosis is the change of the intestinal flora and the suppression of putrefaction.

A second and very important advantage may be gained through the improved nutrition resulting from the absorption of a large amount of easily assimilable iron for building up the blood and the large quantity of lime, especially prepared for assimilation. Milk is a wonderful food product, the elements of which are especially prepared for absorption and utilization by the animal body. In this regard it is unequalled by any other substance known. The liberal supply of iron and lime salts together with the subtle vitamines which have been shown by Funk to be present in milk in remarkable abundance, supply to the emaciated, anemic, drooping consumptive just the elements he requires for building up his resistance and fortifying him against the encroachment of the parasitic disease which is preying upon him.

It is a settled principle in therapeutics that when a cure takes place it is accomplished through the blood; in other words, it is the blood that heals. Hence blood building is of first importance. The fact has already been pointed out that in the special milk regimen which is recommended in this work, the intake of iron is four or five times the amount ordinarily required by an adult and that the iron is presented in a condition most favorable for absorption and utilization.

As has been pointed out by Sherman, the iron presented in milk, bran, fruits and other vegetable products, is much more completely and readily utilized than the iron found in blood or flesh.

The rapid decay of the teeth frequently observed in tuberculosis of the lungs is an evidence of a deficiency of lime, a condition that, in fact, is almost universal in this country on account of the general restriction of the dietary to foods which contain only minute quantities of lime salts. For example, fine flour bread, potatoes, bacon, beefsteak, tea and coffee, sugar, molasses and breakfast cakes, contain practically no lime, yet these articles constitute the substantial part of the breakfast meal in most families. The amount of lime supplied by the dinner and supper menus is not much greater. third the amount actually required by the body; The average intake of lime is only about one-hence, it is safe to assume that every consumptive is in need of an increased intake of assimilable lime. Lime in mineral form such as

chalk, gypsum, mineral phosphates, etc., can be utilized by the body only in very minute quantities. Lime taken into the body in these forms is treated like any other foreign mineral substance.

The lime found in milk is especially prepared for prompt and perfect utilization and the amount contained in milk is very large. Estimates differ from eleven to sixteen grains to the pint. Twelve grains would be a safe average. The twelve pints of milk usually taken as a full milk ration will then furnish the body not less than 140 or 150 grains of lime, nearly ten times the ordinary daily requirement, thus affording the body an excellent opportunity to replenish its wasted stores of this important element.

It is well known that in combating tuberculosis the body makes use of lime salts, which are deposited about the focus of infection in such a way as to wall it off from the rest of the body and thus protect the healthy tissues. It is reasonable to suppose that by a very liberal supply of organic lime this process may be facilitated, especially if at the same time the patient's general vital forces and powers of resistance are given a substantial reinforcement by improvement of the quality of the blood and a substantial addition of living tissue.

Under the milk regimen, judiciously applied, the whole body flourishes. Every organ under the vitalizing influence of an improved quality and increased quantity of blood improves its functioning, building up a better quality of tissue,

and thus the general stamina and the patient's stores of reserve energy are materially increased.

Under the milk regimen the consumptive often may be made to take on flesh at the rate of half a pound a day or even more rapidly. When the patient is much emaciated, a gain of a pound a day or even as much as ten pounds a week is sometimes noted, and by means of carefully graduated exercise, beginning at the end of the first or second week, the quality of the tissues may be so improved that the gain may be by judicious husbanding rendered permanent.

If it be objected that in milk feeding there is an excessive intake of protein, the caloric value of the casein being far beyond the requirements of the body, the simple answer is that only a comparatively small amount of protein is assimilated. The fat and sugar, together with the iron, lime and other salts of the milk are readily and very fully absorbed, but the casein, with a part of the milk sugar, is carried along so rapidly that it reaches the colon without digestion and absorption.

The Milk Regimen in Skin Diseases

Bloch, of Germany, several years ago called attention to the fact that psoriasis, a very obstinate skin malady, may often be made to disappear by the aid of a diet consisting wholly of fruits and vegetables.

Bulkley more than twenty-five years ago called attention to the fact that the elimination of flesh from the dietary exercises a remarkable in-

fluence in promoting recovery from eczema, psoriasis and various other forms of chronic skin disease.

Karell in his first report upon the milk cure, gave an account of the successful treatment of a very aggravated case of skin disease in which the patient suffered from prurigo on the upper part of the thighs. The itching was especially bad at night and was described by the patient as being "insupportable." The patient was finally cured by applications of whey upon the skin surface and a course of milk feeding. The itching was appreciably relieved after five days and steadily decreased until it wholly disappeared and a year later had not reappeared.

In the writer's experience, cases of skin disease usually yield readily to a mixed fruit and milk regimen, combined with applications of the actinic ray, the x-ray or whey cultures of *B. Bulgaricus*.

The application of a whey culture of the *B. Bulgaricus* is a most effective remedy in acute eczema and other irritative skin disorders. The parts should be covered with soft compresses wet with the culture. These cultures are an excellent dressing for surgical wounds and a very valuable remedy for vaginal discharges. When used as a dressing to skin or with vaginal pledgets, five per cent of lactose should be added.

The Milk Regimen in Gout and Rheumatism

It would certainly be misleading to recommend the milk regimen as a panacea for gout or rheumatism, but experience has shown that this simple regimen is capable of rendering signal service in dealing with these very obstinate ailments. The constant association of intestinal toxemia, not only with gout but with various chronic forms of joint disease commonly included under the term rheumatism, has long been recognized. It is also known that in gout, at least, there is almost invariably inefficiency of the renal function as shown by the high content of uric acid in the blood and tissues. Certainly nothing could be more wholly rational than the application of a measure whereby the intestinal flora may be changed and intestinal putrefactions and resulting toxemia eliminated. By this means the kidneys may be relieved of an enormous burden and will thus be enabled to do more efficient work in removing from the blood the waste products resulting from the normal activities of the tissues. The constipation that is practically always present in these cases, at least in latent form, may also be best combated by a combined fruit and milk regimen. The diet has the further advantage that it introduces no uric acid into the body and on the other hand tends to increase the alkalinity of the tissue fluids, thus promoting elimination of uric acid and the oxidation and elimination of tissue wastes of all sorts.

Substitution of the milk regimen for the or-

dinary mixed diet will in many cases of gout give immediate relief from gouty pains and other distresses, and by taking care to adhere closely to an antitoxic and uric-acid free diet the gouty subject may not only remain free from suffering but in cases not too far advanced may gradually eliminate the accumulated gouty deposits. In cases of rheumatism, accompanied by emaciation, the milk regimen often confers great benefit not only by suppressing putrefaction poisons and intestinal toxemia but also by improving the quality of the blood and securing a comfortable addition of flesh.

The Milk Regimen in Exophthalmic Goiter

The clinical findings in cases of exophthalmic goiter point very distinctly toward intestinal toxemia as the probable cause. The continued absorption for a long period of putrefaction products from the intestinal tract overworks the poison-destroying and eliminating mechanisms of the body and finally through over-stimulation upsets the nice balance of the hormone-producing glands that activate and harmonize the essential vital processes of the body, and with the result that the thyroid gland becomes overactive and often very considerably enlarged. Recent observations have shown that the suprarenal capsules are also enlarged.

To attack this condition by surgical means alone or by other measures that address themselves exclusively to the enlarged and over-active gland, is an erroneous method that deals only

with symptoms and effects, and that neglects to consider the primary causes of the pathological state. It is well known that spontaneous recovery occurs in many cases of exophthalmic goiter. The writer believes that he has been able to assist a considerable number of sufferers from this disease to arrive at a cure without the use of surgical or other active measures, by giving attention to the removal of the probable cause of this affection; namely, chronic intestinal stasis.

The milk regimen, combined with the fruit regimen, affords a practical and satisfactory method of rapidly changing the intestinal flora and often produces in cases of exophthalmic goiter a very rapid change for the better. In these cases rest in a horizontal position is required during the entire course of treatment. The patient is, however, asked to take deep breathing movements for three to five minutes every hour. Light passive movements are made to keep the joints supple and to counteract to some degree the baneful effects of inactivity.

It is the writer's belief that a very large proportion of all sufferers from exophthalmic goiter may be wholly relieved without resorting to surgery, and it is important to bear in mind the fact that an overworked gland sooner or later undergoes degeneracy and becomes inefficient; that is, that a person suffering from hyperthyroidism is likely sooner or later to present the symptoms associated with hypothyroidism. The overworked gland cells after a time become worn out and undergo degeneration.

It is evident that if surgery is resorted to and

a portion of the gland removed or rendered inactive by the ligation of arteries or other means, the effect of the procedure will be, not only to cure hyperthyroidism by crippling the gland, but to hasten the time when the gland through degeneracy will be no longer able to perform the work required of it and which is necessary to maintain the proper balance of the internal secretions and to regulate the various processes essential to normal nutrition.

In view of the great number of operations that are now-a-days being performed upon the thyroid gland it seems inevitable that in the not distant future there will develop a prolific crop of cases of myxedema or more properly cachexia strumiprivi. Then patients who become tired of taking dried sheep thyroid will be looking for some surgeon who has discovered a method for permanently restoring the function of the thyroid by some grafting process.

It is clearly evident to the writer that in every case of hyperthyroidism the first effort should be to remove the cause which has produced the disease; in other words, to suppress intestinal putrefactions and if for any reason operative interference is considered necessary, proper attention to the etiologic factor should be considered still more essential because the thyroid has been by the operation reduced in size and hence its ultimate degeneracy and failure made more certain and less remote. Every operated case should be placed upon a low protein diet and should make free use of bran and paraffin. The operation should be preceded and followed by the fruit

regimen continued long enough to clear the tongue and suppress intestinal putrefaction, which has been accomplished when the breath is sweet and the stools no longer foul.

Milk Diet in the Treatment of Syphilis

An English physician, Doctor Westrobe, has recently called attention to the great value of the milk regimen in the treatment of syphilis by salvarsan. Doctor Westrobe has shown that by giving the patient a short preliminary course of the milk regimen, the toxic symptoms which usually follow an injection of salvarsan are either prevented altogether, or are much reduced in severity. Of 100 patients treated in this way, not a single one suffered from rigors after the injection and only one showed albumen in the urine. When the milk regimen was not employed, the patients always complained of severe headache, vomiting and various other complications.

It is quite possible that equally good results would follow the employment of the fruit regimen for a few days prior to the injection. In Doctor Westrobe's cases, the milk feeding consisted of two quarts of milk in twenty-four hours for one or two days before the injection; probably a longer period would be still more beneficial.

The fruit regimen and the milk regimen may render great service in all cases of syphilis by suppressing intestinal putrefactions and so raising vital resistance. In cases of high blood-pressure due to syphilis, the fruit regimen shows

remarkable results in lowering vascular tension. The fruit regimen, like fasting, powerfully promotes the absorption of exudates, and hence is indicated in connection with other measures in cases of gummatous deposits.

The Milk Regimen in Chronic Cases

One of the earliest advocates of the "milk cure" in modern times was Doctor Inozemtseff, of Moscow, who according to Karell, published a work on the "milk cure" in 1857 and reported the successful use of this method in nearly one thousand cases of chronic disease.

Deuss and Preyer of Vienna in 1875, and Hertel and Hoffman still earlier, highly recommended the milk cure in various chronic diseases and especially in renal disorders.

The combined use of the fruit regimen and the milk regimen supplies a still more efficient and versatile method of great value in nearly all classes of chronic disease.

The Milk Regimen in Surgical Cases

When time permits, that is, when the necessity for surgical interference is not pressing, the chances for a successful operation may in a serious case often be very greatly increased by reinforcing the patient's vital resources by means of the milk regimen. In such cases, ten days or two weeks of feeding by this method will not only secure for the patient an appreciable improvement in quality and quantity of blood and a gain in tissue, but increase his resistance and stamina,

which will be of substantial assistance in combating the tendency to shock associated with every severe operation and improving the chances for a sure and rapid recovery.

A proper application of the milk regimen as a preparation for an important surgical procedure is especially indicated in cases in which the tongue is coated or stools foul and the blood depreciated and the weight considerably below the normal. No time is really lost in such cases by waiting a few days before the operation when the case is not one of emergency, for the time required for recovery after the operation is materially shortened by the previous special feeding.

In quite a large proportion of cases the milk regimen may be adopted after a severe surgical procedure as an after-cure. In the writer's hands this method has proved very successful in cases in which operations have been performed upon the stomach or intestines and in other cases in which patients operated upon need a gain in flesh or a change in the intestinal flora. A common practice with the writer is to put the patient on the fruit regimen for three or four days after operation and then, as soon as the tongue is clean and the bowels moving normally, to change to the milk regimen if the patient needs a gain in weight.

The Fruit Regimen

The value of fruit as a means of relieving toxic conditions has been known for ages. Before the study of toxemia or autointoxication by Bouchard the conditions that are now known to be due to poisons absorbed from the alimentary tract were thought to be due to inefficiency or incompetency of the liver, congestion of the liver, and sometimes designated as "biliousness." This condition is now known to be not primarily due to inefficiency of the liver, but to intestinal putrefaction. In case the efficiency of the liver has been reduced by disease, however, a condition of general toxemia may be more easily induced because the protective activity of the liver is lessened. The fruit regimen affords the best possible means of combating these conditions.

The fruit cure has been practiced in various ways. The most familiar is the so-called "grape cure." The patient takes ten to fourteen pounds of grapes a day and a few pieces of zwieback. The seeds and skins are excluded.

Linnaeus tells us of the cherry cure, which he himself employed with advantage.

During the Civil War the diarrhea and the dysentery from which soldiers suffered were relieved during the peach season when the soldiers had access to peach orchards.

At the close of the Spanish-American War the writer observed a very good illustration of the

value of fruits in curing intestinal infections. Medical officers in charge of soldiers prohibited the use of fruits, evidently laboring under the common delusion that fruits are dangerous in case of bowel looseness because they are known to be laxative. But the action of fruits is that of a physiologic stimulant whereas the looseness due to diarrhea is a result of the irritation of the colon by toxins. The bowels act too frequently because of the presence of irritating material. Complete emptying is a most efficient method of terminating the difficulty; hence the evacuating action of fruit is often beneficial. Besides, fruits are rich in carbohydrates, and so supply a medium unfavorable to the development of pathogenic organisms.

The writer had general supervision of a small summer sanitarium at Staten Island when the soldiers were being brought in from Cuba, and as the season had closed the house was empty. A spell of warm weather made it possible to keep the house open a longer time and we took in thirty or forty of the feeblest of the sick soldiers who were being daily brought in. None but very feeble cases were taken, those who were just barely able to stand up. All were suffering with bowel troubles, and all were very weak and emaciated. At the very first meal to which these men were invited to sit down, the long table was covered with fruits of all sorts, watermelons, peaches, pears, apples, grapes, etc. They were allowed to eat freely of all kinds of fruit, and the benefit which they derived from so doing was immediately apparent.

How Fruits Differ

Fruits do not stimulate the bowel by irritation, but by the bulk that they furnish through the cellulose which they contain and through their acids and sugar. Fruits differ in these properties. Apples and pears contain almost no cellulose. Bananas contain none at all. These fruits are little laxative. Cherries, grapes, apricots and peaches contain more cellulose and are more laxative. Prunes contain a considerable amount of cellulose and are highly laxative. Raisins are also laxative as are likewise figs. Dates are less laxative. Huckleberries contain the largest amount of cellulose of any fruit or any foodstuff, in fact, and are very highly laxative. Raspberries and blackberries are laxative but less so than huckleberries.

Fruits that contain much acid are prohibited in cases of hyperacidity, and sometimes in cases of chronic gastric catarrh without hyperacidity, and even in cases of achylia in which the gastric mucous membrane has become hypersensitive to organic acids. In such cases, fruits free from acids should be taken, such as bananas, pears, white cherries, very sweet peaches, cantaloupe, watermelon and casaba melon.

The same preliminary examination should be made as with the milk regimen. The patient should take a carmine capsule, and note the time when the color appears and disappears. The character of the stools should also be noticed, especially the color and the odor. Putrescent stools are dark in color, either black or dark

brown and have an ammoniacal, rancid or putrescent odor.

The Daily Routine

With the fruit regimen the patient takes four meals a day. Each meal consists of fruit,—any kind of fruit the patient desires to eat,—one ounce of bran and one ounce of paraffin oil. If the patient desires, one ounce of brose (a mixture of equal parts by measure of oatmeal, corn meal and sterilized bran) made into a porridge may be added twice a day. Bran may be taken in the form of sterilized bran. For persons who cannot take bran or think they cannot, agar-agar may be used instead. The bran or agar-agar should be divided up into six or eight equal parts and distributed through the meal so as to be well mixed with the other foodstuffs.

The fruit regimen should be continued until the tongue clears off, or at least until it is nearly clear. An appreciable improvement will be noted by the third or fourth day.

After three or four days of the "fruit regimen" the stool generally becomes nearly odorless and consists chiefly of bran. The fruit regimen should be continued until this change occurs, unless the patient is very feeble, in which case the diet may be changed and the patient allowed to take a more liberal bill-of-fare for a few days, when the regimen may be repeated.

In exceptional cases the diet must be continued for ten days or two weeks. When this is necessary, no serious inconvenience will be experienced by the patient provided he is kept at rest.

It is entirely possible, indeed, to continue the fruit regimen for several weeks provided careful oversight is kept over the patient.

In the case of very fleshy persons who are suffering from intestinal toxemia, the fruit regimen may be continued for several weeks and secures a rapid loss of flesh without injury. This regimen is sufficiently bulky to satisfy the patient although the amount of nutrient material taken is really small.

In the case of very feeble or emaciated patients, the fruit regimen may be used for three or four days, and then followed by the milk regimen, which not only serves to perfect and establish the change in the intestinal flora, but secures the very desirable gain in flesh, often at the steady rate of half a pound a day or even twice as much.

The addition to the daily ration of four to eight ounces of milk sugar or of a mixture of equal parts of milk sugar and malt sugar facilitates the change or reform of the flora of the colon as shown by Rettger. This addition of carbohydrates also serves to prevent emaciation and makes it possible to continue the regimen for a week or ten days when desirable so to do.

The Rationale of the Fruit Regimen

The fruit diet has not heretofore been very successful; first, on account of the great amount of bulk required; second, because the best fruits are to be secured only at certain seasons of the year; third, because of the failure to secure active movement of the intestines in many

cases; and fourth, because of the increase of gastric juice on account of the acid present in many instances. The plan here recommended overcomes these difficulties.

First, it permits the patient to eat any kind of fruit he likes as the activity of the intestine is secured by means of bran and paraffin oil.

Second, it is possible to succeed with fruits that contain no acid and little cellulose.

Third, the laxative effects of bran or agar-agar and paraffin oil greatly increases the efficiency of the regimen by getting a sufficient amount of the fruit into the colon to insure the necessary supply of carbohydrate to combat putrefaction.

If necessary, hypersecretion of acid may be combated by olive oil and alkalies while the special regimen is in force.

Thin persons should rest while taking the fruit regimen so as to avoid undue loss of flesh. It is not necessary to remain in bed, but the horizontal posture should be maintained, if not in bed, on a cot or a sofa, and always in fresh air as with the milk regimen.

Breathing exercises should be practiced hourly (see page 293).

How the Fruit Regimen Differs from the Fruit Cure, Fruit Diet, Etc.

The "fruit regimen" is a systematized and rationalized use of fruit as a therapeutic measure, whereas the fruit cure, the fruit diet, etc. are empirical and desultory dietetic methods.

The "grape cure," much practiced in Switzerland, the "cherry cure" by means of which the

famous botanist, Linnæus, cured his gout, and other fruit cures have often been followed by most excellent, sometimes even wonderful results.

The great difficulty that has stood in the way of the popularization of these methods has been the uncertainty of results. In fact, it must be said that in the majority of cases the results obtained by the employment of fruit as an exclusive article of diet, have been decidedly disappointing. For many years the writer made experimental use of the fruit diet in various ways, but rarely obtained results that afforded any considerable degree of satisfaction to either physician or patient. Not infrequently the patient continued to suffer from intestinal stasis or constipation in spite of the consumption of large quantities of various sorts of fruit. Very often patients suffered so much distress from excessive distention of the bowels as a result of fermentation in the intestine that they refused to continue the diet. The difficulty was that the laxative effect of the fruit was not sufficient to empty the colon, and the retention of a large amount of fermentable residue naturally gave rise to a great accumulation of gas and over-distention of the bowel.

The "fruit regimen" overcomes this difficulty through the use of paraffin and bran or agar-agar, thus securing free and frequent evacuation of the colon. It must be continually borne in mind that the chief purpose of the fruit regimen is to change the intestinal flora. Fruit alone will not always accomplish this; in fact, it generally fails, unless supplemented by efficient means for increasing peristaltic activity.

The combined use of fruit, bran or agar-agar, and paraffin, produces results that cannot be obtained in any other way.

By the addition of lettuce, celery, and in some cases salads of carrots, turnips, cabbage, and palm cabbage when available, valuable vitamines are supplied as well as nutrient material, elements of greatest value in rebuilding the diseased and deteriorated organism.

An especial advantage of the fruit regimen is that it is so simple that it may be employed by anyone at almost any time in almost any place. For good results it is only necessary that the rules here laid down should be carefully followed.

By this regimen all the good effects claimed by the advocates of fasting may be obtained without the dangers and inconveniences of total abstinence from food.

The Green Regimen

In certain cases of hyperhydrochloria the stomach is exceedingly sensitive to fruit acids, so that the ordinary fruit regimen gives rise to pain even when bicarbonate of soda and small quantities of olive oil are employed as elsewhere suggested. In such cases fruits may be eliminated altogether and the dietary may be made to consist exclusively of green vegetables, such as lettuce, celery, cucumbers, green corn, cabbage, carrots, turnips, and cooked greens of all sorts, such as spinach (parboiled) dandelion, beet tops, endive, etc. "Brose" (equal parts by measure of oatmeal, corn-meal and cooked bran) cooked

for five to ten minutes may be used twice a day. Otherwise the regimen is managed exactly like the fruit regimen.

When the Tongue Remains Coated

In many cases purées of sweet fruits such as bananas, dates, soaked figs or raisins, and sweet apples, pears or white cherries may be carefully added to the regimen and later acid fruits.

In certain cases the tongue remains coated after the fruit regimen or the green regimen has been closely followed for several days. This is an indication that the normal state of the blood has not been restored. In some cases this may be due to an excessive accumulation of toxic matters in the body; in other cases the cause may be an adherent or pouched cecum in which food residues accumulate and putrefy because the crippled cecum is not able to empty itself. In such cases the only resource is the systematic use of the enema. Three pints of water at a temperature of about 90° F. should be slowly introduced into the colon at bedtime. Five minutes should be occupied in getting the water into the colon so as to give time for it to reach the cecum and thoroughly flush the head of the colon.

In certain cases there may be adhesions of the pelvic colon which prevent efficient bowel action. In such cases a simple surgical procedure may be needed.

Disorders in Which the Fruit Regimen Is Indicated

The "Fruit Regimen" in Disease of the Heart, Blood Vessels and Kidneys

In cases of high blood-pressure, whether due to degeneration of the arteries, to renal disease or to fully developed cardio-vascular-renal disease with or without dropsy, the fruit regimen is capable of rendering valuable service. In these cases there is a constant tendency to acidosis. The urinary acidity is high on this account and the diminished activity of oxidation leads to a continued tendency in the direction of acidosis. A test of the patient's alveolar air often shows marked lowering of the CO_2 tension, a certain proof of the presence of acidosis.

The large amount of acid salts contained in fruits in which an organic acid (citric, malic, or tartaric) is combined with potash and soda tends to alkalinize the tissues or at least to neutralize the acid products present and so renders very great service. The old idea that fruit acids tend to acidify the fluids of the body was long ago shown to be a gross error. The organic acids found in fruits and in certain vegetables are not free, but are combined with bases or alkaline substances. When taken as food these salts are decomposed in the tissue fluids, the acids set free are burned into carbon dioxide and water and the alkaline base left behind enters into com-

bination with the acid wastes present in the tissues and thus antagonizes acidosis.

Another advantage afforded by the fruit regimen is the small amount of protein present. The fruit regimen is practically a carbohydrate diet. The amount of protein present in fruits is on an average a little more than one-half of one per cent. The fruit regimen is thus practically a protein fast. Fats are also practically excluded from the diet. It is well known that protein and fat are the two food principles that in the highest degree encourage putrefaction in the colon. When proteins and fats are excluded from the diet the food residues that reach the colon contain so little albuminous material that the growth of putrefactive bacteria is suppressed. If the fruit feeding is sufficiently abundant a considerable quantity of carbohydrate will find its way into the colon and thus encourage the growth of acid-forming organisms; and even the colon bacillus and allied species, which ordinarily produce toxins, may become acid-formers, thus being transformed into protective instead of disease-producing organisms, especially with lactose feeding.

By this change of flora the production of poisons in the intestine is checked. The blood stream is no longer charged with toxic substances that irritate the delicate lining of the vessels and cause degenerative changes by which the vessels are narrowed and finally obliterated. The liver and kidneys are relieved of the great burden that they had to carry in distoxicating and eliminating the enormous quantities of highly active poisons which for many years have so overtaxed

the capacity of these organs that they have finally become seriously crippled. The fruit regimen, by eliminating one of the most common and active causes of vascular and renal disease, will accomplish for persons suffering from arteriosclerosis with or without high blood-pressure more than can be accomplished by any known drug.

The Fruit Regimen in Renal Disease

Von Noorden is a very warm advocate of fruit in renal disease, as is well known by all who have visited his clinics in Vienna or elsewhere. He says (Von Noorden's "Metabolism"):

"It is the theory of many physicians that nephritic patients should be given a diet poor in proteins (Senator, F. Hirschfeld, Albu, and others). It is said that such a diet puts less strain on the diseased organs. No doubt this is true, for acute nephritis and for the acute relapses of chronic nephritis, as I have emphasized elsewhere. For two years I have been of the opinion that in acute and dangerous cases no nitrogen should be given in the food. I have given nothing but sugar water and fruit juice for from three to eight days at a stretch (often 200 to 300 grams of sugar daily). It was my impression that this form of treatment was very useful, and that uremic symptoms were obviated, or if already present, were removed.

"In acute nephritis, on the other hand, and in the acute inflammatory exacerbations of chronic renal disease, a large protein intake undoubtedly exercises an injurious effect on the albuminuria. Even a milk diet is too rich in protein for this

form of kidney trouble. When the inflammation is at its worst I give nothing but sugar-water (about 150 to 200 grams daily) and strained rice broth, with cream or butter added. This regimen reduces the work done by the kidneys to the lowest limit. I add milk to the diet only when the patient begins to be convalescent."

The "fruit regimen" is still more efficient in cases of renal disease than the "fruit diet" of Von Noorden, because of the increasing intestinal activity and change of the intestinal flora, which lessens the absorption of toxins and the work of the crippled kidneys.

The "fruit regimen" is of special service in cases of parenchymatous nephritis.

The Fruit Regimen in Dropsy

The fruit regimen is often highly successful in cases of dropsy. In dropsy there is an accumulation in the tissues of fluid charged with salt and urea. Because of the inability of the kidneys to eliminate these substances as fast as taken in or produced in the body, they have been pushed out into the tissues and with them there has been retained as a matter of necessity a sufficient amount of water to hold them in a state of solution having such a degree of density as the tissues will tolerate. Every dram of salt which is thus retained, requires the retention with it to hold it in solution of more than a pound of water. A diet free from salt has been found to be one of the most efficient means of relieving dropsy. The rationale is very simple. A certain amount of salt escapes from the body daily no matter

whether any salt is eaten or not. The minimum amount usually lost during fasting is two to four grams or half a dram to a dram. With each dram thus lost is also lost the pound of water holding it in solution. Thus the dropsy gradually disappears. Not infrequently the loss of dropsical accumulations is so rapid as to seem almost magical.

The Fruit Regimen in Obesity

The fruit regimen is especially adapted to the treatment of obesity. Notwithstanding the fact that a sufficient bulk of food is taken to afford the patient a sense of satiety, or to satisfy the appetite, the actual intake of food is not more than half or two-thirds the maintenance ration. The result must necessarily be a steady loss of flesh. With the fruit regimen and a moderate amount of exercise it is easy to reduce the weight of an obese patient half a pound to a pound a day. This rate is too rapid to be continued for a great length of time but may be tolerated for a week or two and will be a source of very great encouragement to the patient.

Intestinal Toxemia, Headache and So-Called "Biliousness"

In this condition, which is commonly indicated by a coated tongue, bad breath and dingy or pigmented skin, very foul stools, and the other well-known symptoms of intestinal toxemia, the fruit regimen is almost a panacea. In all cases in which there is no serious mechanical obstruction to bowel action present, such as adhesions of

the pelvic colon, the fruit regimen may be expected to accomplish the result desired; cases will be found very rare indeed in which the most sanguine expectations will not be fully realized. Almost invariably within three or four days after the beginning of the regimen the stools will lose their foul odor, the tongue will be found very much less coated, the breath less offensive and in a few days more the patient's symptoms will be very greatly ameliorated. If the regimen is followed by a rational atoxic diet the patient will make very rapid and in every way satisfactory progress toward recovery. It is only necessary to manage the dietary in such a way as to keep the tongue clean and the stools free from foul odor. The bowels must move three or four times a day. So long as constipation exists, the good effects of the regimen will be manifested only in a partial way.

If the patient still continues to suffer from headache,—if the tongue does not clear off, and if the foul odor of the breath and stools does not disappear after three or four days, the fruit regimen may be continued for three or four days longer. If necessary, the regimen may be continued for a couple of weeks. It must be remembered, however, that the fruit regimen is partial starvation and so can not be continued indefinitely. In cases in which the full results of the diet are not obtained by the first trial of the fruit regimen, the patient may return to a more liberal diet for a few days, a week or two perhaps, then the fruit regimen may be resumed. In extreme cases the regimen may be repeated three or four times if necessary.

It must be remembered that the coating of the tongue is due to the growth of bacteria in the mouth which is the result of the lowered vital resistance of the whole body. This cannot be completely recovered at once; but if the stools are becoming less foul progress is certainly being made and the complete result will appear later.

The Fruit Regimen in Cachexias and Chronic Disorders

In most cases of this sort definite indications of intestinal toxemia will be found present. While the fruit regimen will not accomplish all that needs to be done, yet it is a very good means for starting the therapeutic campaign. In cases in which there is much emaciation the ration should not be continued for more than two or three days, after which the milk regimen or some other fattening regimen should be employed. In cases of obesity, in myxedema with obesity, and especially in dropsical cases, the fruit regimen may be continued for a few days longer, seven to eight days perhaps, or even two weeks.

The absence of appetite is an extremely common symptom in many cases of chronic disorders and cachexias. A patient whose tongue is coated very often has no desire for food and the flavors of food are unattractive. After two or three days of the fruit regimen, the patient usually develops an excellent appetite. This is a highly favorable omen, for according to Pavlov's dictum, "appetite means juice." That is, when the patient has a good appetite and a keen relish for food it is highly probable that the stomach is

prepared to digest the food and the tissues to assimilate it.

The Fruit Regimen in Surgical Cases

When the tongue is coated, the fruit regimen reinforced by a liberal supply of malt sugar or milk sugar is a most excellent preparation for an abdominal operation of any sort. The same regimen may be begun soon after the operation, usually three or four days, and aids greatly in regulating the bowels, obviating almost altogether the use of salines, castor oil, and other laxative drugs with the exception of paraffin oil.

The Fruit Regimen as an Introduction to the Milk Regimen

The fruit regimen so greatly facilitates the attainment of the results desired of the milk regimen that it serves a highly useful purpose as an introductory measure. By administering the fruit regimen three or four days before beginning with the milk the body is prepared to better utilize the milk; the tongue clears off, the appetite is improved, the bowels become more active, and thus the patient is prepared to take the milk with relish and to digest and utilize it. In many cases in which the milk regimen is indicated, the patient has a coated tongue, a foul breath and is obstinately constipated. It is the writer's custom in dealing with such cases to employ the fruit regimen for three or four days before beginning with the milk.

For "Rice Regimen," "Potato Regimen," and other regimens, see Index.

The Fasting Regimen—"Absolute Diet"

Voluntary fasting probably originated as a religious performance. It was prescribed as penance, or was undertaken for the purpose of encouraging a state of spiritual elevation.

In modern times, fasting has been at various times greatly extolled as a panacea for nearly all chronic disorders. It has been used chiefly by certain irregular practitioners in an empirical way, and sometimes, it must be confessed, with a considerable degree of apparent benefit.

That a person may live without eating for a considerable period has been clearly demonstrated by the experience of Cetti and Succi, the Italian fasters, Doctor Tanner, and others. Professor Luciani, who observed the faster Succi during a thirty days' fast, found him a demented person (formerly insane) who believed himself to be the son of God, and fasted for the purpose of demonstrating the indestructibility of his divine body.

Various professional fasters as well as fasting animals have since that time been studied by physiologists in different parts of the world. The uniform testimony of these expert observers has been that the withholding of food does not exercise the prompt control over intestinal putrefactions that might be expected. It is true that under ordinary conditions putrescible food rem-

nants furnish material for promoting an abundant development of putrefaction organisms in the colon.

On the other hand, food is not the only source of putrescible material in the colon. The bile, intestinal mucus and other intestinal secretions that are constantly poured into the alimentary canal furnish a sufficient amount of putrescible material to maintain a luxuriant putrefactive flora. When these materials are promptly discharged from the body, however, there is not sufficient time for the development of the putrefactive process, which requires much more time than is needed for the development of the fermentative processes to which carbohydrates are subject. In fasting, however, there is almost complete inactivity of the intestine. Food is the natural excitant of peristaltic activity. Whenever food is taken into the stomach, active contraction waves begin at once, traversing the stomach at the rate of three to five a minute, and passing along down the whole alimentary tract. When food is withheld, these movements cease, the biliary and other excretions accumulate and undergo putrefaction; the poisons are absorbed; the tongue becomes coated; the breath foul; the urine is loaded with the products of putrefaction and all the evidences of intestinal autointoxication become intensified.

In the case of the faster Cetti, observed by Lehmann, the first stool after the beginning of the fast occurred on the ninth day. The amount of phenol, a putrefaction product, found in the urine had increased in the meantime to nearly

five times the amount present at the beginning of the fast. The condition of the urine was the same as that which is usually observed in cases of obstruction from peritonitis or other causes, the result of the paralyzed condition of the bowel due to complete abstinence from food.

Examinations of the urine of Succi, the famous Italian faster, made by Apollo and Solard by Bouchard's method showed its toxicity to be greatly increased.

Mr. Horace Fletcher, who fasted seventeen days, found at the end of that time the evidences of autointoxication so aggravated that he was compelled to terminate the fast.

Some years ago a man who had fasted for three weeks consulted the writer on the twenty-first day of his fast. He had begun the fast for the purpose of getting rid of a foul tongue, a bad breath and various disorders which were clearly the result of chronic intestinal toxemia. He was disappointed in finding that all his symptoms had become worse instead of better. His tongue was very heavily coated, his breath very foul, he was sleepless and greatly depressed and nervous.

On inquiry it appeared that his bowels had not moved once during the entire three weeks. In answer to the question when his bowels moved last, he remarked, "I took an enema the day before I began my fast and I have eaten nothing since; of course my bowels have not moved as there is nothing to be moved."

A saline laxative was administered at once and within twenty-four hours the patient had

several large and horribly smelling stools and was greatly relieved. Needless to say this patient was cured of his desire to fast.

Some who have taken very long fasts maintain that if the fast is continued long enough the tongue after a time clears off, appetite returns and a very great physical and mental renovation is experienced. Possibly in such cases the enormous number of putrefactive bacteria retained in the body undergoing digestion and absorption may produce an effect similar to that following the use of bacterial vaccines, conferring a temporary immunity, such as one sees in the convalescence of typhoid fever and some other intestinal infections. But this favorable result is uncertain and a number of cases have been reported in which patients have died while waiting for the tongue to clear and the appetite to return. It is probable that in the most favorable cases the benefit derived from prolonged fasting is obtained at the expense of more or less permanent injury to important vital organs, and that great and unnecessary risk of serious vital damage is incurred.

Starvation suspends the secretion of the digestive juices. "The secretion of saliva diminished in acute starvation even when water was taken ad libitum. Thus Succi, on the seventh day of his fast, only produced as much saliva by the movements of his jaws in three hours as under ordinary circumstances is secreted in five minutes" (Von Noorden).

In fasting the stools are highly putrid and "similar in appearance to the feces passed when

the diet is mainly composed of meat" (Von Noorden).

Says the same author, "The blood atrophies."

Statkewitsch studied the effects of fasting in a large number of animals—cats, dogs, rabbits, pigeons, frogs, lizards, and other animals—and found that after prolonged fasting the cells of the heart, liver, muscles, kidneys, pancreas and other glands were the seat of degenerative processes. These processes were most marked in the muscles and the glands.

Zander found evidences of degeneration of the heart muscles in pigeons after fasting eight to twelve days.

Gaglio found cloudy swelling of the muscles, granular and fatty degeneration of the liver in fasting frogs.

The Fasting Body Feeds upon Itself

So long as life continues, the fasting animal body continues to consume energy although at a reduced rate. The energy output of the body during fasting is three-fifths to three-fourths the ordinary output. In the absence of the usual source of energy, food, the body feeds upon itself. The body is consumed at the rate of about one-eightieth of its weight each day. The stores of fat are first drawn upon, then the muscles, glands and other structures are consumed to keep the fires of the body burning. The heart muscles and some other organs may lose as much as one-half their weight. This process of degeneration may be carried so far that the body can not recuperate itself. According to

the London *Lancet,* the professional faster, Succi, although only thirty-eight years of age, had the appearance of a very aged person; not only his face but his entire body was covered with deep wrinkles. His muscles were so atrophied and degenerated that he looked like a skeleton and had the appearance of a person suffering from incipient marasmus.

Loss of Weight During Fasting

A man of average size when at rest and fasting, burns up about 75 grams (2¾ oz.) of protein (muscle and gland tissue), 25 grams (5-6 oz.) of glycogen (animal starch stored in the liver and muscles), and 200 grams (6⅔ oz.) of fat (adipose tissue), amounting in all to ten ounces of tissue consumed. But this does not represent the total loss of weight for the reason that with each ounce of carbohydrate or protein (glycogen or muscle) consumed, three times the same weight of water is lost, so that the actual loss in weight for the muscle and glycogen burned is 100 grams $\times$ 4 = 400 grams or 13½ ounces. Adding the 6⅔ ounces of fat the total loss in weight is just 20 ounces or just double the weight of the actual solid matter consumed by the body processes. (No water is lost in the burning of fats).

If the patient exercises, the loss of weight will be much greater. It may be easily doubled by a moderate amount of exercise for the reason that muscle work increases very greatly the proportion of energy consumed.

The following table (Von Noorden) shows

the percentage of loss sustained by some of the principal organs and tissues of the body during fasting:

Body Loss During Long Fasting

Fatty tissue	95	per cent
Muscles	40-45	" "
Heart	40-45	" "
Glands	40-45	" "
Blood	40-45	" "
Bones	10-15	" "

The idea that long fasting is necessary to consume accumulated poisonous substances which the kidneys and other organs have failed to eliminate is based upon ignorance of physiologic facts. Chemical analysis shows that the tissues of a dead animal in which decomposition is already well established, contain wastes and toxic matters to the extent of not more than ten per cent of the total solids. Supposing that the tissues of a living man contain the same proportion of toxic material—a preposterous proposition, of course, since life could not exist under such conditions—the amount of waste materials contained in the tissues of a man weighing 150 pounds would be not to exceed four pounds.

It is evident that to submit such a person to an ordeal by which he would lose thirty or forty pounds in weight, involving the destruction of half his muscular structures and nearly an equal proportion of many of the most important vital organs, for the purpose of eliminating three or four pounds of waste materials that may be easily gotten rid of otherwise, is in the highest

degree irrational. It is like setting a house on fire or half tearing it down to get rid of a dead rat in a closet. There are much easier, safer and more efficient means of getting rid of accumulated body wastes. And so while admitting that good, even remarkable results are sometimes obtained by prolonged fasting, the writer feels no hesitancy in condemning this practice as an unnecessarily drastic, unsafe and dangerous method of combating conditions which are clearly due to intestinal toxemia. All the good results obtainable by fasting may be much more easily, safely and efficiently secured by the rational employment of the "fruit regimen" and the "milk regimen" as recommended in this work.

No evidence has ever been produced to show that the body is in any way profited by depriving it of starch and other carbohydrate except in cases of obesity. Sugar (chiefly derived from the digestion of starch) is the fuel of the body. Fat, the other fuel element of the food, must be burned with sugar to make it available. Burned alone it produces incompletely oxidized and poisonous products, resulting in a highly dangerous condition, acidosis. Fats and proteins (albuminous elements) promote putrefaction in the colon and load the body with waste and poisonous products. Carbohydrates ferment, and the acids formed combat putrefaction. It is thus evident that all the benefits to be derived from fasting as a means of blood and tissue purification are more certainly attainable by the elimination of fats and protein only, than by abstinence

from all food. The "fruit regimen" is a fat-protein fast. It secures all the benefits of fasting and avoids all the dangers and inconveniences of abstinence.

More than this, the fruit regimen keeps the bowels open and trains them into the normal rhythm of activity. The over-distended cecum contracts. The spastic descending colon relaxes. The liver and kidneys, no longer overtaxed, rapidly clear the blood of waste matters and toxins and a feeling of well-being and "fitness" is experienced which is an index to the rejuvenating processes which are in progress in the blood and tissues.

A remarkable series of observations made upon certain low forms of animal life has recently shown that after a period of starvation a process of rejuvenation is set up by means of which senile conditions which had previously existed are made to disappear, apparently a real renewal of youth. It is not to be claimed of fasting that it is a fountain of youth as some of its advocates have insisted, but there can be no doubt that a protein fast as by means of the fruit regimen is one of the best possible means of renewing one's youth. Numerous cases, some hundreds, in fact, might be cited in support of the value of the fruit regimen as a rejuvenating process.

The Antitoxic Diet

After the flora has been changed, the patient must adopt and follow consistently a strictly antitoxic diet. Meats of all kinds must be definitely discarded. No exception can be made in favor of "white meats," fish, or shellfish. White meats are as objectionable in every way as red meats, and fish and oysters are much worse. Oyster juice is swarming with putrefactive bacteria. The stomach and intestines of the oyster present many varieties of bacteria. Often the typhoid bacillus is found in the oyster. Analysis of oyster broth shows its composition to be very nearly like urine.

The diet must consist largely of fruits and vegetables, especially fresh vegetables. Cereals should not be made the staple of the diet. The alkaline salts of fruits and vegetables are needed to counteract the effects of chronic toxemia.

Condiments, tea and coffee, vinegar and strong cheese must be discarded. Commercial butter is often objectionable on account of the multitudes of pernicious bacteria that it contains.

Of course the diet must be low in protein, but milk may generally be used in moderation, and often eggs may be used sparingly. The yolks are much preferable to the whole egg. In certain cases animal proteins of all sorts must be avoided. This is required in the cases of persons who have been sensitized to animal proteins, or to certain of them. Persons subject to severe

headaches or attacks of urticaria are likely to belong to this class. Recent investigations show that raw white of egg is highly indigestible and hinders the digestion of other foods.

A Low Protein Diet Safe

That a diet from which animal proteins is wholly excluded is safe and competent is attested by all modern physiologists. Says Prof. D. Spence, in Von Noorden's monumental work on metabolism, "The old question as to whether the protein of vegetable origin is in respect of value as a food-stuff equal to that of animal origin—whether omnivorous man, like the herbivora, could with impunity draw his entire supply of protein from the vegetable kingdom alone, is in principle one which is already decided for us through the practice of those people who live exclusively on vegetable foods. Physiological investigation can therefore only supply the evidence that it is indeed true that the vegetable-albuminous substances as they occur in nature are equal in nutritive value to an equivalent quantity of protein of animal origin."

Professor Chittenden, of Yale University, whose world-renowned experiments established the safety of the low protein ration, for many years has lived on a diet that furnishes little more than one ounce of protein daily or less than one-third the amount prescribed by the Atwater ration.

Says Dr. A. E. Taylor, Professor of Physiologic Chemistry in the University of Pennsylvania, in his "Chemistry of Digestion and Meta-

bolism," *"A proper vegetarian diet is in every way a normal and competent diet.* Plant proteins contain the same amino-acids as animal protein and all are there present in abundance. It is quite immaterial to the body whether it forms its two stock proteins from amino-acids derived from plant protein or from animal protein."

Professor Milroy* thus incidentally at once endorses and commends the low protein diet as a means of prolonging life and increasing efficiency:

"To arrive at a diet rich in energizing material and poor in protein, one that may also offer variety and be sufficient for the bodily requirements, is the endeavor of the scientists.

"However, such a doctrine will not attract too many admirers, or at least will not bring them in as adherents, for the majority of men, even with the tempting prospect of prolongation of life, or at least rejuvenation, prefer to enjoy the comforts of life" and die prematurely.

Recent observations indicate that for complete nutrition a strict vegetable regimen must include nuts, which supply elements found in meat, milk and eggs, but deficient in cereals, fruits and vegetables.

Uncooked Foods Beneficial

But another element is necessary for best results. Soon after Metchnikoff called attention to the fact that the colon produces indol, skatol and other highly deleterious substances capable of setting up degenerative changes in the body when

* Von Noorden's "Metabolism."

absorbed into the blood stream, Bienstock called attention to the fact that the colon bacillus is also capable of producing lactic acid and other acid products. So while Metchnikoff condemned the colon bacillus as a cause of premature senility through the poisonous products of the putrefactive processes set up by it, Bienstock extolled the colon bacillus as an organism friendly to human life on account of the fermentation of carbohydrates caused by it.

A warm controversy was for years waged between the followers of Metchnikoff and those who followed Bienstock. These divergent views were finally reconciled by Kendall, who as the result of a highly interesting research discovered that nearly all the micro-organisms found in the colon, as well as many other pathogenic organisms, including the diphtheria bacillus, undergo complete change of character in the presence of carbohydrates and set up fermentative rather than putrefactive changes and produce only harmless acids instead of the virulent poisons, ptomaines and toxins that they produce when grown in a culture rich in protein.

These various observations made evident the important fact that the intestinal flora may be changed in two ways: first, by suppressing the growth of putrefactive organisms, and second, by changing the character, or at least the mode of activity of the colon organisms, without actually getting rid of the micro-organisms themselves. To effect this remarkable change by which the virulent poison-forming organisms are converted into harmless acid-formers, it is only necessary

to supply the bacteria growing in the colon with an abundance of available carbohydrate.

Uncooked Starch Useful

Fortunately this can be accomplished in a very simple way; namely, by introducing into the dietary a sufficient amount of uncooked or imperfectly cooked starch. Carbohydrate in the form of glucose or maltose is very quickly absorbed, being rapidly sucked up by the absorbent vessels of the upper part of the small intestine. Cane sugar is more slowly absorbed, having to undergo the digestive process of inversion before it can be absorbed. Milk sugar is likewise more slowly taken up; but both of these sugars are under ordinary conditions wholly absorbed from the small intestine, never reaching the colon where they are needed to tame and transform the "wild" bacteria which abound in this region, converting them through a change of diet into harmless acid-formers.

Cooked starch likewise is so rapidly changed by the saliva, pancreatic juice and the intestinal juices, first into malt sugar, then into dextrose, that it likewise undergoes practically complete absorption in the small intestine, scarcely one per cent of carbohydrate finding its way into the colon. It is because of this absence of carbohydrate that the destructive changes taking place in the unutilized food remnants is usually of the nature of putrefaction instead of fermentation.

To change this condition it is necessary to introduce into the colon a sufficient amount of carbohydrate. Fortunately this may be very

easily accomplished by a method that has been practiced for hundreds of years. The Scotch housewife prepares oatmeal for her family by mixing the meal with water in a pan and stirring while pouring on boiling water. The preparation is served without further cooking. The American housewife would say that oatmeal prepared in this way was raw and unfit to eat. We are prone to forget that our primitive ancestors were able to exist without the aid of cookstoves. History does not tell us when or how fire was discovered, but there can be no doubt that the ancestors of the human race for countless ages subsisted upon the natural products of the field and forest unchanged by any culinary process, as our near relatives the chimpanzee, orang-utan and other anthropoids still do. Oatmeal has for ages been a staple food of the Scotch. Doctor Johnson in his day was quite justified in defining oatmeal as a food for horses in England and for men in Scotland and the Scotchman who took the lexicographer to task for this exhibition of spleen against the Scotch people was equally justified in his retort: "And where do you find such foine horses as in England and such foine men as in Scotland."

Old writers on health, such as Sir John Sinclair, in "The Code of Health," highly commend the scalded oatmeal or "brose" of the Scotch, a dish known also as the "stir-about" among the Irish, who made it their principal food with buttermilk.

When well cooked, the starch of oatmeal, as well as all other cereals, is practically all digested

and absorbed in the small intestine; but when cooked for five minutes or less a considerable portion escapes hydration and being more slowly digested reaches the colon before it has been rendered soluble and absorbable by the intestinal juices.

The starch that thus escapes digestion is, of course, lost to the body as nutriment, but in supplying food to the billions of hungry colon bacilli that inhabit the lower segment of the intestine, it performs a protective function even more important than that of supplying nourishment to the body. As a matter of fact, also, the small loss which is thus occasioned may be readily compensated for by a slight increase in the food intake. In other words, in arranging the bill-of-fare it is necessary to provide suitable pabulum for the micro-organisms growing in the colon as well as for the hungry body cells.

From the above facts it is evident that to maintain a normal bacterial action of the colon whereby harmless acids instead of poisonous products will be produced, it is necessary that the dietary should furnish regularly at least a modicum of starch in its natural or uncooked state. This may be accomplished by the use with each meal of a certain amount of fresh uncooked food in the form of lettuce, cabbage, etc., and by the use of cereals imperfectly or partially hydrated by incomplete cooking. I have had made careful estimations of the carbohydrates in several hundred stools and have found that in highly putrid stools the proportion of carbohydrate is usually about one-half per cent or less. When the per-

centage of carbohydrate is increased to two or three per cent the putridity is greatly diminished or disappears.

A Simple and Excellent Breakfast Food

An excellent breakfast food for the antitoxic ration, which is much to be preferred as an antitoxic food to the breakfast foods in common use is the following:

Mix together equal parts by measure of corn meal, steel-cut oats and sterilized bran. Stir this mixture into boiling water in sufficient amount to make a rather thin porridge. As soon as the mixture thickens, or not more than five minutes after beginning to stir the meal, the porridge should be removed from the stove and is ready to serve at once. This preparation is not only far more wholesome than the long cooked cereals but is more palatable than oatmeal and other similar preparations served in the usual way.

Avoid Excess of Fats

One more point to be noted in relation to the antitoxic diet is the avoidance of an excess of animal fats. Animal fats in large amount promote intestinal putrefaction. This fact was pointed out by Combe. Animal fats also when taken in excess undergo fermentation in the colon, giving rise to butyric acid, which gives to the stool a strong rancid odor, while butyric acid is not only itself toxic but gives rise to still more highly toxic substances. Vegetable fats are less likely to do harm than animal fats. Strong butter is particularly harmful since it not only

contains butyric acid, a very poisonous substance, but also a rich culture of the organisms which give rise to butyric fermentation. An antitoxic diet should exclude all fats except vegetable fats and butter freshly made from sweet or sterilized cream.

The Stomach Needs Time for Rest and Disinfection

The interval between meals should be sufficient to afford the stomach an opportunity for rest. The gastric glands exhaust their energy by long continued activity and need rest. But this is not all. The stomach requires disinfection after each meal. If no time is allowed for this, infection is likely to occur. The need for rest for disinfection has been very clearly shown in the feeding of young children by Czerny and Steinitz (Von Noorden's "Metabolism"). The principles laid down by them in the following paragraph apply equally well to adults:

"As the power of human milk to combine with HCl is less than that of undiluted cow's milk, so the antiseptic power of the stomach contents of the naturally fed child is greater than that of the artificially fed. Moreover, the system of three to four hour pauses between meals, especially advocated by Czerny, is supported by this fact. For since in the case of healthy, naturally-fed children, free HCl appears in the gastric contents at the earliest in one and a quarter hours, and in the case of artificially-fed children first in two hours, a thorough disinfection cannot be attained without allowing a considerable interval.

If this is not inserted between two meals, the stomach has not the time to disinfect its contents, and the way is thrown open to all possible invasions. Besides, Czerny and Wachsmuth have also drawn attention to this defect, and have attempted to explain by its means the higher mortality of artificially fed children (often 20 to 1)."

The emptying time of the stomach in healthy adults is four and one-half hours. Allowing an hour for rest and disinfection, the interval between meals for the average healthy person should be not less than five and a half hours from the beginning of one meal to the beginning of the next. Observing this rule, it is impossible to eat more than two substantial meals in a day without encroaching upon the sleeping hours. Nothing is more unphysiologic than to go to bed soon after eating a hearty meal. This is one of the most prolific causes of insomnia.

Experience has shown a good plan to be to breakfast at 8 a. m., dine at 1:30 p. m., and to take a fruit lunch (including bran and paraffin) at 6:30 to 7:00 p. m. Fruit and bran require practically no digestion; but the most important fact is that a meal of fruit (lettuce and celery may be included) does not introduce into the blood the nerve exciting elements that are derived from a hearty meal, especially when meat and eggs are freely eaten. After such a meal there is usually drowsiness and there is no trouble in getting to sleep, but by two or three o'clock in the morning the blood is flooded with the products of digestion which excite the brain and nerve centers and so cause wakefulness.

A Laxative Diet is Essential to Maintain an Atoxic Condition in the Intestine

In the majority of persons suffering from chronic intestinal toxemia the carmine test meal appears first only at the end of twenty-five hours or longer and will disappear only after the lapse of forty-eight or more hours. Not infrequently the color will be still observed after three days and in one case under the writer's observation the carmine was last seen at the end of one hundred and forty-two hours or nearly six days from the time it was taken.

Observations show that in persons suffering from constipation, even in latent form, there is a very great accumulation of material in the intestinal tract. It is evident, for example, that in a case in which the color does not make its appearance until at the end of twenty-four hours or longer there is accumulating during the intervening period the residues of the several meals taken during this time together with the bile and other excretions which have during the same time been excreted into the intestine. Much larger accumulations occur in cases in which a still slower motility is observed.

When the color is long in disappearing it is evident that the bowel never empties itself, but always retains larger or smaller fractions of the meals taken during several days. The writer has noted several cases in which the carmine reappeared after once having appeared and disappeared. In one case an interval of twenty-four hours elapsed between the first disappearance and the second. This might easily occur in a case

with a greatly distended cecum, an uncolored meal passing over an accumulation of colored material in the cecal pouch and appearing first.

Three Bowel Movements Needed Daily

Increased frequency and completeness of bowel movement is nearly as essential for the restoration of a normal condition of the intestinal flora as regulation of the diet. The normal intestinal rhythm is three or four bowel movements daily or at least one movement after each meal.

The chimpanzee and other of the larger apes move their bowels three or four times daily. I was informed by the animal keeper of the London Zoo that the large apes in that great collection uniformly move their bowels four times a day. The small monkeys have more frequent bowel movements. They eat constantly. The keeper of the big chimpanzee at the Washington (D. C.) zoo states that five or six bowel movements daily is the rule with his big apes.

Doctor Hornaday, Superintendent of the Bronx Zoological Garden, informs me that the large monkeys in his collection move their bowels three times a day. By correspondence with many missionary doctors practicing among primitive people in Africa and other foreign countries, I have learned that the bowel habits of people living in a wild or primitive state are identical with those of the higher apes.

One Daily Bowel Movement Is Constipation

The average American citizen, however, considers himself a model of regularity and physical rectitude if he has one bowel movement daily without the use of drugs or pills. Nevertheless, it is no exaggeration to say that the average adult American is suffering from intestinal toxemia. Women suffer more than men as a result of sedentary life and wrong habits of dress. It is difficult to find an adult woman who does not show more or less indications of chronic toxemia, though probably the majority if charged with being intoxicated would protest vigorously, if perhaps with less frankness than was shown by a woman who consulted the author some years ago. When told that she had autointoxication she showed much indignation and exclaimed very vehemently, "You are mistaken, sir; I am not intoxicated. I have not taken a drop since night before last. I confess that I do usually take a toddy at night to make me sleep but I took none last night."

The lady was not comforted when we explained to her that the intoxication from which she was suffering was even worse than alcoholic intoxication because continuous, whereas alcoholic intoxication is usually intermittent.

The effects of intestinal toxemia are on the whole in the writer's opinion quite as bad as those of alcoholic intoxication in its ordinary manifestations. When the bowels move thoroughly three times a day or after each meal, or better still, four times a day, once after each meal and on retiring or immediately on rising

in the morning, the time during which the unused food residues remain in the colon is too short to allow for the development of advanced putrefaction processes and if the diet is of proper character, low in protein, rich in carbohydrate, supplied with a reasonable amount of starch in its native state, the stools soon cease to show marked evidence of decomposition, the strong ammoniacal, putrid or rancid odors disappear, the stool has either a faint sweetish or slightly sour odor, and the black or dark brown color gives place to an orange or yellow color.

How to Combat Constipation

In persons who are fairly normal these changes may be brought about very quickly by regulation of the diet and a voluntary effort to move the bowels after each meal; but in persons who have been chronically constipated for years, other measures are necessary. Means must be employed to combat chronic constipation systematically and continuously. It is not proper, however, to resort to the habitual use of laxative drugs, such as castor oil, cascara sagrada, senna, etc. Salines and even laxative mineral waters must be avoided. All of these things do harm. They invariably aggravate the spastic condition of the descending colon almost always present.

Laxative drugs also produce an exaggeration of the anti-peristaltic movements, which begin in the transverse colon and travel backward toward the cecum. These movements are natural during digestion but do not interfere with the periodical movement of the intestinal contents. Colitis, rec-

tal constipation and especially the use of laxative drugs greatly exaggerate this anti-peristaltic action and so increase the tendency to stasis in the cecum and the ascending part of the colon. It appears to be more than probable that this exaggerated anti-peristalsis set up by mechanical obstacles to normal bowel function existing in the distal colon is the chief cause of dilatation of the cecum and incompetency of the ileocecal valve, which is brought about by the over-distention of the cecum.

Bran and Paraffin

In the great majority of cases of constipation, even very obstinate cases, in which a natural movement of the bowels has not occurred in many years, the difficulty may be quickly overcome by increasing the bulk of the food intake and by adding a lubricant in the form of paraffin oil. The modern diet in civilized countries is by far too highly concentrated. The human intestine is adapted to a bulky diet. The average bill of fare leaves practically no residue after the digestive process is completed. This fault may be easily corrected by the addition of sterilized wheat bran in sufficient amount and by the free use of fresh fruits and green vegetables.

For normal persons living on a biologic diet bran would not be necessary, but persons who have been for years constipated have crippled colons, the colon is dilated and elongated, its muscular walls are weakened by long continued over-distention, and the mechanical stimulus furnished by a very bulky dietary is essential.

Such colons are also crippled by degeneration of the glands that normally furnish an abundance of lubricating mucus. This is particularly true in cases in which the appendix is diseased or has been removed but is also true in practically all cases of chronic constipation. This permanent deficiency may be compensated for by the use of paraffin oil which acts purely in a mechanical way, lubricating the intestinal wall so as to facilitate the onward movement of the colon contents. One or two tablespoonfuls of bran and one-half ounce to two ounces of paraffin oil taken at every meal will usually secure three or four bowel movements daily. The bran should be mixed through the meal. The paraffin oil should be taken a short time before the meal. Neither the oil nor the bran act as laxatives in the ordinary sense. They do not irritate the bowel. The bran stimulates the bowel not by irritation but by a sort of titillation, hastening peristalsis in both the small intestine and the colon, and by hurrying on the unused residues of each meal leaving no opportunity for the development of putrefactive changes. Bran also excites the intestine to action by distending it, and by the same means stimulates the activity of the glands which furnish the digestive fluids.

When Surgery is Needed

In the comparatively small number of cases in which these measures fail the cause is a clearly defined pathological condition, such as incompetency of the ileocecal valve, constriction of the ascending colon due to Jackson's membrane, a

spastic condition of the descending colon due to reflex irritation or colitis, a prolapsed and incarcerated or adherent pelvic colon, a spastic or paretic rectum, a spastic anal sphincter or the existence of tuberculosis, carcinoma or other causes of mechanical constriction in some part of the colon. In cases of this kind, other special measures of treatment, either medical or surgical, as the case may require, must be instituted. Let it suffice to say for the moment that by the application of the proper means relief may be afforded in every case. Constipation is always curable and the intestinal flora can always be changed if sufficiently thoroughgoing measures are adopted.

Avoid Eggs

The common practice of combining raw eggs with milk is highly objectionable. The observations of Vernon and others, have clearly shown that raw white of eggs is not well digested in the human alimentary canal. The undigested albumen greatly promotes putrefaction in the colon and hence does much harm. Yolks are less objectionable but not needed.

Practical Suggestions for Relief of Constipation

If the bowels do not move three times a day, prompt measures should be taken to make them do so. Without being aware of the fact, all persons whose bowels move only once a day are constipated.

Proper tests show that with many persons the waste matters discharged have been lying in the colon undergoing putrefaction for several days so that every bowel movement is a belated movement. The offensive materials that are discharged today should have been discharged yesterday, the day before, or even several days before. Cases are sometimes observed in which, although the bowels move regularly, the movements are always several days in arrears. Modern physiologic observations have proven that the unusable remnants of each meal and accompanying wastes should be discharged within twelve to twenty-five hours after the meal is eaten.

The following suggestions have been thoroughly tested in the treatment of many thousands of persons suffering from constipation, and have been found to be effective.

1. *The bowels normally move three or four times daily.* Eating starts up active movements of the intestine which naturally lead to a bowel movement after each meal. In the majority of

persons a bowel movement occurs soon after rising in the morning. With many persons a bowel movement occurs just before going to bed. Frequent bowel movement which occurs naturally is not weakening but wonderfully promotes vigor, endurance, appetite, digestion, and all that pertains to good health.

2. An effort should be made to move the bowels on rising, soon after breakfast, after each meal and on retiring, whether there is or is not a "call" for bowel movement, and at any other time when even a slight "call" is experienced. A persevering effort should be made to secure at least three movements daily and at regular times.

3. Meals must be regular in time and amount of food taken. Food is the physiologic laxative. A scanty meal, or the omission of a meal, means the interruption of the intestinal rhythm—omission of a movement, or an incomplete movement. Fasting, a scanty diet (less than 1,600 to 2,000 calories), a liquid diet (milk, gruels, broths), a diet chiefly consisting of such foods as potatoes, rice, meat, eggs, white bread, tea, coffee, and condiments, are constipating. Something should be eaten at the regular meal time if only fruit or bran and paraffin.

4. The importance of bulk or undigested residue as an aid to intestinal activity is well shown by the facts pointed out by Spence who tells us that "herbivorous animals, like the rabbit, die when fed on food which leaves no residue. Adult human beings are not so constructed that they can exist on diets which leave no residues. The importance of these food residues

is emphasized in the term 'intestinal scourers' that has been given them. The carnivores, too, do not dispense with them willingly; just as they devour bones, so do the graminivorous birds swallow sand, feathers, and the like." (Von Noorden's "Metabolism.")

Cellulose (the indigestible part of vegetable foods) is the only element that can increase the bulk of the feces in man. The average person requires about an ounce of cellulose daily. In cases of chronic constipation a larger amount is required.

A convenient form of cellulose is sterilized bran. Ordinary bran contains much dirt and abounds in vermin. Specially prepared or sterilized bran is now obtainable everywhere and may be used in combination with oatmeal and other cereals. An excellent breakfast food may be prepared by mixing one-third bran and two-thirds oatmeal, cornmeal or other cereal. Such a mixture will be ready to eat after five minutes' cooking. Longer cooking is unnecessary and detrimental. Agar-agar or Japanese gelatin, another form of cellulose, is a very efficient laxative. In its commercial form it is inconvenient for use. It may be obtained in sterilized and convenient form ready for use.

5. Agar-agar aids bowel action by preventing drying and hardening of the intestinal contents and filling the intestine sufficiently to stimulate it to action. The physiologists have discovered that the intestine possesses a peculiar kind of sensibility known as "muscle sense." When the in-

testine is stretched, the muscle sense is stimulated and the intestine is thus made to act.

6. The bowel requires lubrication. Normally a peculiar mucus secreted by the appendix and the colon furnishes sufficient lubrication. When the appendix or the colon have become diseased by long continued constipation or colitis, the glands are destroyed and the normal mucus is not produced in sufficient quantity to properly lubricate the bowel. The necessary lubrication can be supplied best by the use of a special petroleum product, first obtained from Russia, known as white refined Russian paraffin oil. Since the war this product has become very scarce and is difficult to obtain, but a similar product has been produced in this country. The only objectionable features of paraffin oil are that in its natural state it contains unwholesome substances that may give rise to irritation and other undesirable effects. Many people also find it difficult to take on account of its oily character. These objections are overcome by special treatment of the paraffin that includes very thorough washing, whereby the objectionable substances are removed and by emulsifying the oil so that it will mix with water. In this state it resembles milk in appearance and may be easily swallowed without the slightest inconvenience. It produces no disturbance, even in the most sensitive stomach.

Paraffin lubricates the colon, protects the diseased mucous membrane, hinders absorption of poisons and dissolves and carries off the toxins of putrefaction. Bran and paraffin are harmless

substances that may be used continuously without injury, and by regular use render possible the training of the bowel to normal action. In cases in which the colon has been permanently crippled, they must be used permanently, though in some cases their use for a few months is sufficient to restore normal bowel action.

7. Green vegetables (excepting the potato) contain much cellulose. This is especially true of beet root, turnip, parsnip, spinach, cabbage, brussels sprouts, and lettuce.

8. Exercise promotes bowel action, especially walking, horseback riding, calisthenics and such special exercises as trunk bending, leg raising, and deep breathing. Exercises and deep breathing movements taken on the inclined table are especially helpful and should be practiced several times daily.

9. Various other means are highly beneficial, such as massage of the colon, vibration and kneading of the abdomen. In special cases, applications of electricity to the abdominal muscles, the rectum, the pelvic colon, and other internal applications render great service.

10. In cases in which the abdominal muscles are relaxed, and the colon and other portions of the intestine are prolapsed, an efficient abdominal supporter should be worn either permanently or until the abdominal muscles have become strong enough to hold the viscera in position.

11. Drugs of all kinds must be avoided. They do not cure, and do much harm when repeatedly used. There is no such thing as a harmless laxative drug. Mineral waters and saline laxative

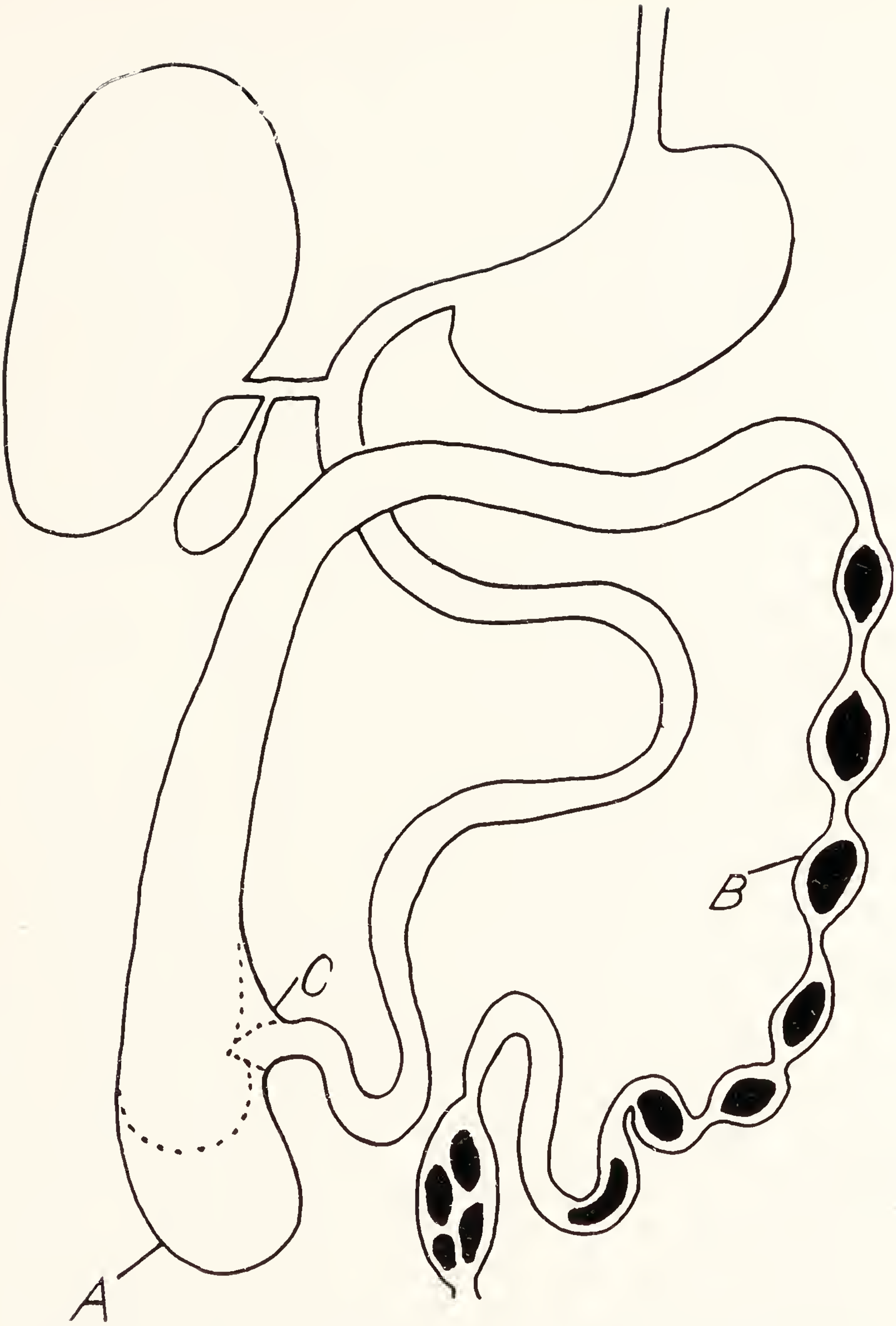
pills are harmful, and produce enteritis and colitis sooner or later, and destroy the mucous membrane and so encourage autointoxication by opening the way for absorption of poisons.

12. The squatting position secured by using a raised foot-rest in front of the closet seat is a great aid to bowel movement, especially in cases in which the abdominal muscles are relaxed, a condition most common in chronic constipation.

13. In cases in which the measures above indicated do not secure prompt relief from constipation, an x-ray examination by aid of the bismuth meal should be made. By this means a minute inspection of every part of the intestine is possible. In many cases "kinks," folds, contractions, adhesions, displacements, and other impediments to normal bowel action are found, which may be corrected by the application of appropriate measures. Such an examination should be made in all cases of unusually obstinate constipation.

When Constipation Does Not Yield to Regulation of the Diet with Addition of Bran or Agar-agar and Paraffin Oil

While these cases are comparatively rare the number is sufficiently large to deserve attention. In by far the great majority, perhaps nine-tenths of all the cases of obstinate constipation, the seat of the trouble, as shown by both clinical observations and x-ray studies, may be definitely located in the rectum, at least in the last two segments of the large intestine, the rectum and the pelvic colon. The most common conditions found present are at the lower extremity of the gut;



A. Dilated Cecum; B. Spastic Colon; C. Incompetent Ileocecal Valve. Competent Valve Shown in Dotted Outline.
DIAGRAM OF ALIMENTARY CANAL

a spastic anal sphincter caused by fissure, ulcer, hemorrhoids or reflex irritation; a spastic condition of the entire rectum; redundancy of the upper valve of Houston; obstruction of the gut at the pelvi-rectal junction due to adhesions or to a spastic condition of the muscular structures of the junction; a prolapsed and incarcerated pelvic colon; a prolapsed and adherent pelvic colon; a spastic pelvic colon or adhesions and spastic contraction of the gut at the ileo-pelvic junction.

Associated with these conditions and with a spastic condition of the descending colon there is generally found a pouched or adherent cecum and an incompetent ileocecal valve. Jackson's membrane may become a source of mechanical obstruction when the transverse colon is prolapsed to an unusual degree.

The warm enema added to the other measures suggested in foregoing pages and in the author's work, "Colon Hygiene," will rarely fail to keep the colon sufficiently well cleared to prevent toxemia. Colon massage (deep digital), and sleeping on the left side are also useful measures. When all dietetic and physical measures fail as is sometimes the case, radical relief may be obtained by appropriate surgical measures. A spastic anal sphincter may be dilated; ulcers and hemorrhoids may be removed. A redundant Houston's valve may be divided; adhesions of the pelvic colon may be broken up and the pelvic colon suspended by attachment to the omentum which in turn is attached to the abdominal wall; Jackson's membrane may be divided and the ileocecal valve may be re-

paired. If the proximal colon is so badly distorted and crippled that it cannot be made to functionate properly it may be removed. If the resected portion includes the first half of the transverse colon the disturbing effect of antiperistalsis will be gotten rid of along with the damaged colon. The small intestine may then be joined to the transverse colon, and if an artificial valve is constructed the bowel may be made to functionate in a perfectly normal way.

The operation of short circuiting for relief of the condition known as Lane's kink, or adhesions of the terminal ileum, is rarely indicated. It is unphysiologic to leave a blind end. As a matter of fact "Lane's kink" is rarely, if ever, a cause of ileac stasis and hence short circuiting will not relieve this condition. Temporary relief may be experienced, but sooner or latter the trouble will reappear. The usual cause of ileac stasis is incompetency of the ileocecal valve.

In very pronounced cases of intestinal toxemia it is sometimes extremely difficult to establish permanent improvement without the repair of the valve. Simple repair of the valve, however, is not likely to prove efficient unless the conditions of which it is a result, that is, spasticity of the descending or pelvic colon or adhesions or incarceration of the pelvic colon or other conditions which produce mechanical hindrance in the distal colon, are also relieved.


Roentgenogram Showing Enlarged Cecum (Case)


Roentgenogram Showing Spastic Colon (Case)

Accessory Treatment

The ordinary "milk cure" usually consists simply of rest with feeding of a liberal quantity of milk.

Occasionally massage is added. In the writer's experience this exclusive method is far less efficacious than a combination plan in which the "milk regimen" proper is supplemented by such other physiologic measures as are appropriate or as may be indicated in individual cases.

It is not suggested that any fixed routine of treatment should be followed in all cases, but great service may be rendered the patient by the employment of various hydriatic and other procedures. In general the following measures will be found of substantial benefit in connection with the milk regimen:

The Neutral Full Bath

The patient should take a daily full bath. The temperature of the bath at the beginning should be 100°.

After two minutes the temperature of the bath should be reduced to 92° to 95° for ten minutes. Just at the end the temperature is reduced to 85° F. and the patient is rubbed vigorously for one to two minutes. The "bubble" bath is particularly beneficial.

The Sinusoidal Bath

The application of the sinusoidal electrical current in connection with the bath is advantageous. This combined bath is an excellent means of maintaining activity of the circulation, both of the skin and the muscles, and so promotes normal heart action. The result is improved capacity for utilizing and storing a liberal amount of the large supply of nutriment placed at the disposal of the body. The temperature of the bath should be four degrees lower than the neutral bath or 92° to 88°.

The best time for the neutral full bath or the sinusoidal bath is just before retiring. This is a most excellent means of promoting sleep.

Morning Tonic Bath

Every morning, soon after waking, the patient should be given a cold wet hand rub or mitten friction. To be efficient the application must be made in a systematic manner.

The following description is condensed from the author's work, "Rational Hydrotherapy."*

Water at 40° to 75°, with plenty of Turkish towels, a Turkish sheet, and a woolen blanket, are the only requisites for this bath. In beginning the application the attendant stands with his side to the couch, facing the patient, dips both hands into the water, then applies them, one to each side of the patient's face, covering as large an

* "Rational Hydrotherapy." By J. H. Kellogg, M. D. Good Health Publishing Co., Battle Creek, Mich.

area as possible. Friction is made from the median line outward, the tips of the fingers sweeping over the brow and describing a sort of semicircle along the cheeks to the under side of the jaw. Repeat the movement three to six times. In men, wet the hair by shampooing with wet fingers or a wet towel.

Before wetting the face, a dry Turkish towel should be folded about the head in such a way as to protect the ears, and if the patient is a woman, the hair also, a precaution which will be much appreciated by nervous patients.

Next the application is made to the chest, both hands being employed, first the upper part, then the sides of the chest being rubbed vigorously, then the abdominal surface. After the entire chest has been gone over three or four times with quick, short movements and considerable pressure, the towel is thrown over the chest and the surface dried quickly, the rubbing being continued until the surface is reddened. The face and head are not to be dried until the end, as it is desirable that these parts be cooled by evaporation.

The arms, legs, and back are then gone over in a similar manner.

The treatment concludes with an application to the feet of water at the same temperature as that applied to the head. The ankles and dorsum of the feet should be vigorously rubbed, and the sole percussed with energy, but not rubbed, on account of the unpleasant tickling sensation induced.

Not more than five to fifteen seconds should be occupied in rubbing any part with the wet hand

before the application of the towel. If the rubbing is insufficient to produce reddening of the surface, light spatting or percussion should be applied after drying. Good reaction should be secured in each area treated before proceeding to another portion of the surface.

The skin must be warm at the time of the application. An excellent hour for this is before rising in the morning.

Instead of the bare hand a mitt of coarse cloth may be used. The mitt should be re-dipped in cold water every few seconds.

The Cold Towel Rub

After the first few days, the cold towel rub may be substituted for the mitten friction and later the half sheet rub or the full rubbing sheet may be employed. For full directions concerning the use of these baths see "Rational Hydrotherapy." The following brief description will suffice for a trained nurse who is fairly familiar with hydriatic procedures.

The patient should lie in a recumbent position with all his clothing removed, and wrapped in a Turkish sheet and a woolen blanket, a portion of the covering being laid aside so as to expose the portion to which the application is to be made. The head, face, and neck are first bathed with the colder water, in which one of the towels is also wet, and wrapped about the head. A linen towel is then wrung very dry out of the water prepared for the purpose in the pail. After being quickly shaken out, it is applied smoothly to the part to be treated; and with the hands ap-

plied in such a manner as to cover as large a portion of the towel as possible, they are rapidly moved from point to point with firm pressure, so as to bring each part of the towel successively in close contact with the skin. The rubbing should be continued until the towel is warm, when it may be removed; the dry towel is then placed upon or wrapped about the part, and it is rubbed until the skin is dry and *well reddened by reaction.* The corresponding part of the opposite side is then treated in like manner. If the patient is decidedly neurasthenic, special attention should be given to the back; while if the case is one of cardiac insufficiency, special attention should be given to the chest, arms, and legs.

The hands are rubbed upon the towel, but the towel is not rubbed upon the skin. Particular attention should be paid to this. The effect desired is not produced by mechanical irritation of the skin, but by the assistance rendered the circulation by the intermittent pressure upon the tissues. The hands are applied with long, rapid, alternating strokes, falling upon the surface with sufficient force to give a decided percussion effect. The friction movements may be alternated every few seconds with gentle percussion. The whole surface of the towel should be gone over constantly until it is warmed.

The temperature of the water must be maintained at the initial temperature. This may be accomplished by employing a number of towels, so that no towel is used twice in the same application. A plan which the author prefers as more practical, however, is the following: Two pails

or bowls of water are prepared, one of which is ten degrees lower than the temperature at which the application is to be made. The usual temperatures will be 60° and 50°. The face, neck, and head are cooled with the cooler water. After a towel has been applied to a surface and rubbed until warm, it is dropped into the cooler water, where it remains while the part is being dried and rubbed. In preparing the towel for a new application, it is gathered and squeezed, then dipped into the other pail (60°) and wrung out.

After rubbing with the cold wet towel, the part is dried and then another part heated until the whole body has been gone over.

In drying, the dry towel should be applied and held in place, or a corner of the Turkish sheet may be drawn over the part in such a way that long strokes may be made without displacing it or the patient may assist by holding one side.

The Rubbing Wet-Sheet

A linen sheet, a Turkish sheet, two towels, a tub containing hot water for the feet, a pail of water at 60° to 70° are needed. The temperature may be higher or lower as indicated.

The patient, being prepared, the head cooled in the usual way and protected with a cold wet towel, stands in the tub of hot water with the dry sheet wrapped about him. The attendants prepare the wet sheet which should be wrung dry enough so it will not drip rapidly.

The wet sheet is wrapped about the patient in such a way as to completely envelop him and touch the skin everywhere.

As soon as the patient is thus enveloped,—an operation which should be completed in 5 to 8 seconds,—both attendants begin to rub vigorously, covering the whole surface as quickly as possible, one the legs and hips, the other the trunk and arms. The rubbing should be continued for one to three minutes, or until the sheet is everywhere thoroughly warmed. The attendant should bear in mind that *the patient is not to be rubbed with the sheet, but over the sheet, with downward percussion strokes.* The bath does not depend for its effects upon irritation of the skin by the friction of the sheet, but upon the thermic stimulation and the assistance to the cutaneous circulation afforded by intermittent pressure upon the surface vessels. The rubbing movements are made with a sort of glancing percussion stroke from above downward. Percussion may be applied over the fleshy parts. Gentle patting should be applied to parts that are sensitive to rubbing. Care should be taken that the whole surface of the body is gone over many times and in rapid succession.

When the sheet is well warmed, it is dropped, the Turkish sheet thrown about the patient, and the bath completed by vigorous rubbing over the Turkish sheet, followed by dry friction with the hand, with or without oil rubbing.

Cold applications not only stimulate the skin but greatly improve the action of the heart and lungs, deepening respiration and strengthening the contractions of the heart. The oxidation processes of the body are also increased and hence assimilation is promoted.

Massage

In the application of massage, especial attention should be given to the abdomen. The author's method of applying massage to the abdomen has been fully described elsewhere.*

In cases in which the stomach does not readily empty itself great assistance may be rendered by special gastric massage several times a day.

In massage of the colon care must be taken to apply deep digital pressure to the colon along its whole length where accessible. Particular attention must be given to the cecum. By this means alone the colon may be made to contract.

The Surf Bath

The surf bath is a bathroom substitute for swimming and surf bathing. It is a most delightful bath for a morning tonic and next to swimming is perhaps the best form of exercise for stimulating metabolism. This bath is especially valuable for obese patients for the reason that it has more than double the effect in increasing metabolism of the ordinary cold bath as shown by the increased consumption of oxygen.

The Air Bath

For very feeble patients the cold air bath is often better as a morning tonic measure than the cold water bath. While the body or a part of it is exposed to the cool air the skin is vigorously rubbed with the hand, a towel, or a soft flesh brush, until a good reaction is secured as shown

* "The Art of Massage," J. H. Kellogg, M. D. Modern Medicine Pub. Co., Battle Creek, Mich.

by a brightened color of the skin due to improved circulation of blood.

The Wet-Girdle

At bed time a moist abdominal bandage should be applied and worn during the night. The method of application is as follows: Wring a towel out of cold water so dry it will not drip. Place around the body and cover first with mackintosh then with several thicknesses of flannel so as to warm quickly and keep warm. The effect is that of a poultice.

In cases of chronic colitis, when gastric and intestinal irritation exists, also in cases of chronic appendicitis and whenever there is a sensitive condition of the viscera, as shown by deep pressure upon the abdomen, the moist abdominal bandage may be applied with great advantage both day and night. Care must be taken that the bandage is kept moist. The moist abdominal bandage is highly advantageous in cases in which there is any tendency to nausea.

In cases in which the patient complains of pain with disposition to vomit, complete relief may usually be obtained by the use of the combined compress. This consists of the wet-girdle combined with a hot application over the stomach. A few minutes before eating, the wet-girdle should be freshly applied and a rubber bag filled with hot water should be placed over the stomach. This simple measure has an almost magical effect in overcoming gastric irritability with nausea. It is of great service in the vomiting of pregnancy.

Vibration is another valuable means of stimulating the sluggish colon. Vigorous, penetrating vibratory impulses are necessary to secure definite results. Vigorous vibration of the anal region is a most effective means of awakening a desire for bowel movement. The dumbell vibrator was designed especially for use in vibrating the colon and is very effective.

Electricity, especially the sinusoidal electrical current, is of great service in cases in which the rectum has lost its normal sensibility. A natural bowel movement often occurs at once after a local application of the sinusoidal current with a bi-polar electrode.

Exercise

After the first week the patient should begin methodical and carefully graduated muscular exercise. The amount of work done must, of course, depend upon the patient's strength. Persons of average strength may begin by walking half a mile and back. The length of the walk may be increased an eighth of a mile each day; that is, the second day the distance traveled would be five-eighths of a mile and back which would make a total distance of a mile and one-quarter. The third day the distance would be three-fourths of a mile and back, a total distance of a mile and one-half, or an increase in actual walking distance of a quarter of a mile each day.

At this rate of increase the distance walked at the end of the third week from the beginning of treatment, will be four miles. This distance walked twice a day will insure a notable increase in muscular strength and breathing capacity.

At first the walking should be at a very leisurely rate, not exceeding two miles an hour. As the strength increases, the rate may be gradually increased until the pace reaches the rate of three miles an hour.

This amount of exercise will not so greatly increase the consumption of food as to materially lessen the rate of gain, and may, in fact, increase the appetite and the rate of assimilation sufficiently to actually increase the gain in weight.

A matter of much greater importance is that by means of the exercise the growth of the muscular tissue will be encouraged so that the increase in weight will not be due simply to the accumulation of fat, but will include a growth in the muscular structures, a much more permanent and useful gain than the mere addition of reserve tissue in the form of fat.

Breathing Exercises

Breathing exercises, when properly taken, render the greatest service in promoting the movement of the milk from the stomach into the intestine, in encouraging bowel action and in promoting the absorption and circulation of the digested food. In deep breathing, each inspiration produces upon the absorbents of the small intestine the effect of a suction pump, drawing in the digested liquid from the cavity of the bowel. Each descent of the diaphragm in deep breathing compresses the stomach and facilitates the movement of liquids from the stomach into the intestine.

Deep breathing also greatly aids the circulation of the blood, lightening the work of the heart and energizing its contractions by drawing the blood toward the heart, not only from the abdomen, but even from the extremities.

The following exercises are particularly to be recommended:

1. Remove the pillow from under the head and place two pillows under the hollow of the back. This will raise the lower part of the chest and render the abdominal muscles tense. The

patient should take deep breaths at the rate of about eight or ten breaths a minute, expanding the lungs as fully as possible. The effect is to increase intra-abdominal tension and so encourage the movement of the undigested food out of the stomach and along the intestine.

2. The patient lies upon the face over a pillow, or better, a hair cushion. In this position the abdomen is compressed by the weight of the body. Breathing practiced in this position greatly encourages peristalsis and absorption. The breathing exercises should be practiced five minutes every hour when the patient is awake. The best time is just before feeding time.

3. The patient lies on the back with a sand bag upon the abdomen. The weight of the bag should vary from ten pounds to twenty-five according to the patient's strength. By practicing deep breathing at the rate of eight or ten breaths a minute the circulation in the stomach and intestine and hence the rate of absorption may be encouraged. This exercise also encourages intestinal activity.

Compression of the stomach by the diaphragm assists greatly in emptying it of its contents. Compression of the intestines and the portal vessels simultaneously with the production of a negative pressure in the chest producing a suction action upon the circulation in the abdominal organs, greatly encourages the movement of blood in the portal veins and the movement of lymph in the lymphatics and so promotes absorption to a high degree.

Exercises on the Inclined Table

The efficiency of breathing movements may be very considerably increased by the use of the "inclined table." A table especially constructed for the purpose may be used or an inclined table may be improvised. A board of suitable width and length—an ordinary ironing board answers the purpose very well—is placed in position with one end on the floor, the other raised two feet.

The patient places himself upon this inclined plane with the head at the lowest point. In this position he executes the various breathing movements that have already been described. By the use of the inclined table gravity is made to assist in relieving the congested viscera of their surplus blood and thus promoting the absorption of the digested food and securing a better distribution of blood throughout the body.

A dozen excellent exercises may be taken with the aid of this table, all of which are well calculated to encourage increased activity of the colon. These are described at length in the author's work, "Colon Hygiene."

Posture

This is a matter of much importance. In sitting, standing and walking, the chest must be held up. In sitting and in lying on the back, the small of the back should be supported by a firm cushion to insure correct breathing, which is possible only when the chest is held well up.

In sleeping, the left side lying position favors bowel action.

Eating for Health and Efficiency

Errors in diet are very largely responsible for the majority of the chronic ailments which afflict the civilized portions of the human race. This is particularly true of maladies which affect the alimentary canal. It naturally follows that the adoption of a biologic diet is of first importance in any serious attempt to cure patients suffering from disorders of nutrition.

The following simple rules if faithfully followed should enable a patient who has changed his flora and gotten a new start in life by the aid of the fruit regimen and the milk regimen, to maintain and greatly add to the improvement which he has secured by the aid of these specific regimens.

1. Eat only natural foods; that is, those which are naturally adapted to the human constitution. The natural dietary includes fruits, nuts, cooked grains, legumes, and vegetables. Natural foods impart to the body the greatest amount of energy, and maintain normal conditions of life. No animals but scavengers and men eat everything. We should follow our nearest relatives, the orang and chimpanzee, in diet.

2. Avoid meats of all sorts (flesh, fowl, fish, including "sea food"). These are unnatural foods. They are all likely to contain parasites of various kinds, and countless numbers of noxious germs, "meat bacteria" or "wild germs," which infect

the intestines, cause putrefaction and other poison-forming processes, and inoculate the body with colitis and many other diseases. These germs are not destroyed by ordinary cooking, such as stewing, broiling, frying, and roasting.

3. Take care to avoid an excess of protein; that is, the albuminous element which is represented by lean meat, the white of eggs, and the curd of milk. An excess of protein promotes putrefaction, and thus intestinal autointoxication, the chief cause of "biliousness," colitis, appendicitis, gall-stones, arteriosclerosis, possibly cancer, Bright's disease, and premature old age. Ordinary bread contains a sufficient amount of protein, as do also other cereals. Most nuts, also ripe peas and beans, contain an excess of protein.

4. Eggs should be eaten in great moderation, if at all. They encourage autointoxication, and thus often cause "biliousness." The yolk of the egg is more wholesome than the white. Eggs and even milk as well as meat may be discarded if nuts are eaten.

5. Such animal fats as lard, suet, and ordinary butter, should be avoided. They are difficult of digestion, and promote intestinal autointoxication, and thus cause "biliousness." Vegetable fats are more easily digestible, and do not encourage intestinal autointoxication. Butter must be perfectly sweet, and should be made from certified or sterilized cream.

6. Persons who are not subject to casein dyspepsia are often able to digest sterilized cream more easily than butter. Persons who suffer from hyperpepsia—"sour stomach"—may take

sterilized butter and cream more freely than those who suffer from slow digestion. When butter and cream produce pimples on the face, a coated tongue, or a bad taste in the mouth, they must be diminished in quantity, or omitted. Nuts, malted nuts, ripe olives, and olive oil are excellent substitutes for butter and cream.

7. Avoid poison-containing foods. Tea, coffee, chocolate and cocoa contain poisonous alkaloids which impair digestion, damage the nerves, and promote disease of the liver, kidneys, and blood-vessels. Hot fruit juices and vegetable broths are the most wholesome substitutes for tea and coffee.

8. Condiments — mustard, pepper, pepper sauce, cayenne, capsicum, vinegar, hot irritating sauces, and spices of all kinds—must be wholly discarded. They irritate the stomach and cause gastric and intestinal catarrh and gastric ulcer, colitis, and damage the liver and kidneys.

9. Common salt, or chloride of sodium, should be used sparingly. According to Richet and others, the food naturally contains all the chloride of sodium actually required by the body, so that the addition of salt to the food is necessary only to please a cultivated taste. A safe rule is: *The less the better.*

Persons who have dropsy, Bright's disease, arteriosclerosis, gastric ulcer, hyperacidity, obese persons, and epileptics should discard salt.

10. The quantity of food should be adapted to the size of the person and the amount of work which he does. Never eat to satiety. A person of average height and moderately active requires

250 calories of protein (1-10), 750 calories of fat (3-10), and 1,500 calories of carbohydrates (6-10), or a total of 2,500 calories or food units, daily. This is furnished by the following: Bread, 13 oz.; milk, 12 oz.; potatoes, 10 oz.; butter 2½ oz.; rice 1½ oz.; cream, 3½ oz.; apples 8 oz.

11. Weigh once a month. To reduce weight, eat less and exercise more. Eat one-third more when doing hard muscular work. Mental work requires no more food than loafing.

12. Food must be well relished to be well digested. According to Pavlov, "appetite juice," which is produced by stimulation of the nerves of taste by palatable food, is the most important factor in gastric digestion. Eat when hungry, never because it is meal time, or because invited to eat.

13. Cane sugar should be eaten only in small quantity. Large quantities cause acidity and give rise to gastric catarrh and indigestion. Sweet fruits, such as raisins and figs, honey and malt sugar, are natural and wholesome sweets and may be eaten freely.

14. A sedentary life tends to produce intestinal inactivity, that is, slow digestion and constipation; hence, the ordinary daily bill of fare should supply an adequate amount of laxative foodstuffs, fresh, sweet fruits (not preserved), especially figs and prunes, acid fruits and fruit juices, fresh vegetables, bran, whole grain preparations.

15. Some fresh uncooked food should be eaten at each meal in the form of fresh fruits

or fruit juices, lettuce, raw cabbage, cucumber and other salads.

16. Fresh vegetables and whole grain cereals are needed to supply lime, potash and other salts. The blood and all living cells require these salts, as do the teeth and the bones. The free use of cane sugar and meats lead to lime starvation, because of the deficiency in lime, as does also white bread. Eat baked potatoes freely in place of bread and other cereals.

17. Avoid complicated dishes and great variety at one meal, but vary the diet from day to day as the appetite may indicate.

18. Eat at regular hours, so as to maintain the normal intestinal rhythm which demands three daily movements of the bowels. Rather than omit a meal entirely, eat some fruit, or a cake of colax (agar-agar) with fruit juice, or some other simple nutrient which will keep up the peristaltic procession and rhythm.

Never take food into the stomach when remains of a previous meal are present.

19. The best meal plan is to eat twice a day. Eight to nine a. m. and three to four p. m. are the best hours; or eleven a. m. and six p. m., if the retiring hour is necessarily very late. When breakfast is omitted or taken very late, it is an excellent plan to take some fruit soon after rising.

20. If three meals are eaten, the heartiest meal should be taken at midday. The breakfast should be substantial, the evening meal very light, especially avoiding pastry, fats, rich sauces, and hearty foods. The evening meal should

consist chiefly of ripe or cooked fruits, liquid foods, and such cereals as boiled rice or cereal flakes.

21. Avoid iced foods and drinks. Very cold food or drinks, if taken at all, should be swallowed slowly and in very small quantities to avoid chilling the stomach.

22. Chew every morsel until reduced to a purée in the mouth. Thorough chewing develops "appetite juice" in the stomach and combats intestinal autointoxication, a most prolific cause of disease. Careful mastication affords opportunity for the nutritive instincts to select the food and food elements adapted to the body needs, and to say "Enough," at the proper moment. Hence, give preference to dry foods. Sip liquid foods slowly, taking care to insalivate thoroughly.

23. Dismiss work, worries, business cares and annoyances while eating. Good cheer promotes good digestion. Anger, worry, irritation stop digestion.

24. What we eat today will be walking about and talking tomorrow; hence all foods not known to be pure and wholesome should be avoided. Especially avoid rich and so-called hearty (hard to digest) foods, and such indigestibles as pickles, green olives, and preserves.

25. Take three or four pints of water a day, including liquid food.

Do not drink much at nor immediately after meals. Take a few sips whenever thirsty.

Drink a glassful of water on rising in the morning, on retiring at night, an hour before each meal, and two or three hours after eating.

26. Cleanse the mouth and teeth thoroughly before and after each meal, on rising and on retiring. A foul tongue and decaying teeth indicate mouth infection with intestinal autointoxication and general low resistance.

27. Putrid, foul smelling stools are an incation of intestinal autointoxication, and are usually due to an excess of protein in the form of meat or eggs or to decay (stasis or stagnation) in some part of the colon. Such a condition always breeds disease and indicates need for a "change of flora" through change of diet.

28. The bowels should move thoroughly three times a day, most naturally soon after each meal. Many persons also move the bowels soon after rising. Train the bowels by trying to move them on rising and after meals.

29. Several small bowel movements daily, chronic diarrhea, is a form of latent constipation. The cecum is probably loaded with highly putrid feces. The colon should be completely emptied at least once daily.

30. It is an error to suppose that a well-formed stool is a sign of health. Such a stool is proof of constipation. Such stools occur in persons whose bowels move only once daily, a condition of constipation. In such cases the colon is distended by the accumulated residues of six or seven meals.

The Significance of the Coated Tongue

The older physicians of the last century gave great attention to the tongue and associated its various appearances with certain disorders of the liver, such as "biliousness," and torpidity, and a variety of gastric disorders. The opinion prevailed very widely at one time that a coated tongue indicated a deficient secretion of gastric juice and a clean red tongue the opposite condition; but the introduction of the Ewald test meal showed that a coated tongue was even more frequent in cases of hyperhydrochloria than in cases of hypohydrochloria.

As more accurate means of diagnosis have been developed in the study of gastric disorders, it has become more and more clearly apparent that no very close relation exists between disease of the stomach and tongue coatings. Boas, an eminent authority in gastric maladies, declares that there is no parallelism between gastric affections and the appearances of the tongue.

The tongue, having been discredited as an indicator of gastric disease, has come to be neglected and treated as a matter having little if any significance. This has been true especially since Duran pointed out that a coated condition of the tongue is found in eighty-five per cent of all cases of disease, and since Mueller and

Fuchs showed (1898-1900) that sixty-two per cent of apparently healthy people have coated tongues.

A microscopic and bacteriological examination of the coating of the tongue shows it to be made up of epithelial cells, molds, yeasts and bacteria. A potato culture medium inoculated with material gathered from a heavily coated tongue is in a few days covered with a luxuriant growth of molds, yeasts, and bacteria. A great variety of organisms may be sorted out and among them are found the colon bacillus, the gas-forming bacillus of Welch, and various species of streptococci, pus-forming organisms, many of which are possessed of a high degree of virulence, and which may give rise to pneumonia, rheumatism, and other systemic diseases, to say nothing of pyorrhea, dental caries, and various other oral disorders.

Before we can begin to understand the significance of the coated tongue we must know how the tongue becomes coated. Why is not the tongue always coated? The bacteria, mold and yeasts which are found in the "coating" are always being taken into the mouth with the breath and the food. Certain kinds of food, particularly cheese, milk, and meats of all sorts, are swarming with bacteria. Ordinary street dust consists largely of bacteria. The mouth daily receives many millions of these parasitic organisms. Why do they develop as shown by the coating of the tongue in some persons or at some times and not in all persons and at all times?

The answer is simply this. Under perfectly normal conditions bacteria may enter the mouth, but they cannot establish themselves and grow there. The healthy saliva is able to prevent the growth of germs. This property the saliva derives from the blood. It is a part of the remarkable provision made by Nature by which the body defends itself against the attacks of its microscopic enemies.

The living cells and tissues of the body are endowed with power to defend themselves against bacteria. Bacteria introduced into the blood quickly disappear. They are combated by the opsonins and bacteriolysins, the white cells of the blood, the microphags. The lymph and other fluids possess the same power to destroy germs and prevent their growth.

The healthy mouth is constantly bathed with the saliva which, when it enters the mouth, is not a mere solution of digestive ferments, but is a living fluid containing myriads of cells which are capable of capturing and destroying bacteria in great numbers. This living fluid, teeming with microphags, bathes every oral surface, the teeth, gums, tongue, fauces, finding its way into every nook and cranny of the mouth so that no part can escape its cleansing and disinfecting influence.

In order that the saliva shall be efficient, it is necessary that the blood from which it is formed shall be in a normal condition with high resisting power. If any condition is present which lowers the resistance of the blood, this fact may be

revealed in the loss of the germ-destroying and inhibiting power of the saliva.

When the resistance of the saliva is lowered, there is no hindrance to the growth of bacteria and molds, and a growth of these parasites, or so-called "coating," appears upon the tongue.

The true significance of a coated tongue, then, is not indigestion, but lowered vital resistance. It is for this reason that, as one medical writer says, "most sick individuals have a coated tongue. This symptom indicates that there is something wrong in the economy." And the something wrong is lowered vital resistance.

The cause of this lowering of vital resistance is a flooding of the body with poisons in amount greater than it is able to destroy and remove promptly. The source of the poisons may be various. They may be derived from typhoid or pneumonia germs or some other acute infection. There can be no doubt, however, that the most common and hence most important source of these resistance-destroying poisons is the bacteria of the colon.

In the colon of a constipated person putrefactive bacteria are constantly producing in great quantities highly active poisons, among the best known of which are indol, skatol, phenol (carbolic acid) and ammonia. A portion of these poisons is fixed by the intestinal mucous membrane; another portion is detoxicated by the liver; but when large amounts are produced during a long period, these protecting devices fail and the poisons then accumulate in the blood.

In consequence the blood cells are poisoned, the vital fluid is changed, its resistance is lowered, and every fluid derived from it, including the saliva, is likewise changed.

With these facts before us it is not difficult to understand why eighty-five per cent of all sick people have coated tongues and that sixty per cent or more people apparently in good health have coated tongues. The constipation to which this condition is nearly always due is almost universal among civilized people.

The injurious effects of constipation are not always evident at first. So long as the natural defenses against these germ poisons remain intact, the blood is kept free from them and ill effects do not appear. But sooner or later these wonderful protective mechanisms become impaired and then the bodily resistance is rapidly lowered, the tongue becomes coated more and more and a long train of mischief begins which ends in high blood-pressure, hardening of the arteries, premature senility, Bright's disease of the kidneys, and various other degenerative changes.

The close association of a coated tongue with constipation has long been recognized. The old-fashioned doctors of the last century applied the term "Podophyllum tongue" to the well known yellow or brown coated tongue associated with the condition popularly designated as "biliousness" under the supposition that a disturbance of the biliary function is indicated. The "liver torpidity" which the yellow or brown coat was

supposed to indicate was treated by the doctors of the last generation by doses of calomel and salts, but this treatment was only temporarily successful, for the calomel did nothing more than to partially disinfect the colon and so lessen the amount of poisons produced. And repeated use of the drug made matters worse by producing irritation and lowered resistance of the mucous membrane of the colon, resulting in chronic colitis. In this condition the filtering power of the intestine is largely lost so that the absorption of toxins is increased and the mucous membrane also doubtless loses its power to retain indican and other toxins and thus the toxemia is increased. Much may be said also about the ill effects of repeated doses of calomel upon the liver and other organs.

That arch medical heretic, Dr. Oliver Wendell Holmes, in one of his charming medical essays wrote, "A silversmith will, for a dollar, make a small hoe of solid silver which will last for centuries and will give a patient more comfort, used for the removal of the accumulated epithelium and fungus growths which constitute the "fur," than many a prescription with a split-footed R (℞) before it, addressed to the parts out of reach."

Among the many interesting relics shown at Mt. Vernon, the home of George Washington, is the silver tongue scraper used by the Father of our country in harmony with the custom of that time.

Doctor Holmes was right. Half a century ago he discovered what we have later learned, that

cathartics will not cure constipation and that the tongue may be cleared with a silver hoe more advantageously than with doses of calomel and salts.

From the foregoing it is evident that for practical purposes we may consider a thick persistent coating of the tongue to be an indicator of toxemia due to intestinal stasis or stagnation. In most cases, there will be found delay not only in the colon but in the small intestine as well. The cure is to be found in the suppression of the intestinal putrefactions which are the source of the poisons. This cannot be done by antiseptics, by cathartics, or by active drugs of any sort. These methods have been tried for centuries and are acknowledged to be inefficient. The only radical cure is to be found in so changing or reforming the intestinal flora that putrefactions will cease and thus the normal resistance of the blood and vital fluids may be restored.

The methods by which this may be done have been described in the foregoing pages of this volume and if perseveringly and intelligently applied will be found successful.

Metchnikoff's Mistake

The late Professor Metchnikoff, the senior savant of the Pasteur Institute, who startled the world by several notable discoveries, like many another great discoverer, himself failed to profit by the results of his researches as he might have done. He discovered the cause of old age, the secret of great longevity, but died at the early age of seventy-one years, when to have verified his theories he should have lived to the age of one hundred years at the least. He believed the normal limit of human life to be one hundred and fifty years.

Thousands of persons felt a keen sense of disappointment when the news of the great scientist's death was flashed across the Atlantic. And the disappointment was not wholly due to the fact that Prof. Metchnikoff had failed to reach the goal which he had set for himself and all humans, but the keenest pang was due to the feeling that his philosophy had failed.

The greatest problem before the human race during all the ages of its conscious history has been how to defeat old Father Time in his machinations against human life, how to postpone to the latest possible moment the fulfillment of the ancient fiat, "Dust thou art and unto dust shalt thou return." Professor Metchnikoff's discovery that the cause of old age is poisons generated by bacteria in the colon, and his theory

that the poison-producing germs could be ousted and replaced by beneficent, health and longevity promoting bacteria, opened a door of escape from the clutches of the great destroyer, at least a means of postponing one's funeral if not indefinitely for a very comfortable term of years, perhaps indeed until one had had enough of mundane experience to welcome the end of the long battle and quiet rest in returning to the bosom of the Mother Earth from which we sprang.

The comparatively early death of the great French professor fell upon these budding hopes like a blighting frost. If the professor's theories could not save him, what good can they do me? was the question asked in the hearts of thousands of men and women and discussed at hundreds of dinner tables.

Had the Metchnikoff philosophy failed? Had his theories collapsed when subjected to the final proof of practical test?

We answer, *No;* most emphatically, NO. Metchnikoff's great discovery still stands. The apparent failure of his theory in his own case was the result we believe of an error on his part, not in his theory of the cause of premature senility, but in his method of combating the cause. One highly essential factor of defense he seems to have wholly overlooked, a factor of more importance than any other.

Metchnikoff made the wonderful discovery that putrefactive organisms, poison-forming germs growing in the colon, are the essential cause of old age, at least of premature old age.

He noted that the colon is an incubator of germs and a generator of germ poisons. He observed that those animals which have the longest colons have the shortest lives. His assistant, Doctor Tissier, made the discovery that the process of fermentation due to acid-forming germs, antagonizes the process of putrefaction and poison-forming by preventing the growth of putrefactive germs. Metchnikoff exploited Tissier's discovery and created a demand for "buttermilk germs" all over the civilized world.

Metchnikoff recognized the fact that the intestinal flora may be largely controlled by diet. He maintained that the colon is a useless and harmful appendage which might well be dispensed with. One thing he apparently overlooked, namely, that the evils attributed to the colon are not essentially due to this organ, but are due rather to the stagnation of its contents, in other words, to constipation.

One cannot easily believe that Nature has made so great a blunder as to provide the human race with a useless and even mischievous organ. The real trouble is not with the colon, but, as suggested by Keith, the eminent English anatomist, the fault is that the human colon has been, in modern times, at least, subjected to abuses which it is not prepared to withstand. The human colon, as Keith intimates, was intended by Nature to receive and dispose of the residues of a diet similar to that of the chimpanzee, the orang-utang and other of the anthropoid apes. This residue would naturally consist of cellulose in the form of seeds,

fibers, skins of fruits, etc., together with a certain quantity of raw and undigested starch. Such a residue will not putrefy in the colon, for it furnishes no food for putrefactive germs; it will ferment or sour if retained for a few hours and the acids generated will act upon the colon as powerful stimulants, leading to vigorous peristaltic action and prompt discharge of the fermenting mass.

The diet of modern man is such, however, that the food residues which reach the colon are like those of a dog, a cat or other carnivorous animals, consisting, in part, at least, of undigested and putrefying fragments of animal flesh. The products of the decomposition taking place instead of being acid and stimulating the colon are ammoniacal and poisonous and paralyze the bowel so that it is powerless to expel its seething contents. The result is thus an increase of the stagnation. The bowel becomes inflamed, overstretched, paralyzed, contracted, prolapsed, kinked, and crippled in various other ways. Instead of promptly discharging the unusable residue of each meal within ten to twenty hours after the meal is eaten by three complete bowel movements daily, the colon retains its contents for several days or until it becomes filled and distended with molding, putrefying, highly poisonous feces. The colon may move once a day, but it is never emptied, and is all the time several days in arrears.

The necessity for three full bowel movements daily, one after each meal, seems not to have occurred to Metchnikoff. Neither did he adopt

the logical and obvious conclusion indicated by his premises by discarding flesh meats from his dietary. One of his ablest assistants said, in reply to a question asked by the writer, "Metchnikoff eats a pound of meat and lets it rot in his colon and then drinks a pint of sour milk to disinfect it. I am not such a fool. I don't eat the meat."

Another of Metchnikoff's assistants, Prof. Distaso, then bacteriologist of the Royal Institute of Public Health, London, England, who was said by Metchnikoff to know more about intestinal bacteria than any other living man, told the writer that after his work in the Pasteur Institute as assistant to Metchnikoff he had no further use for meat as an article of food and discarded it from his table. He declared "the whole English nation is suffering from antointoxication as the result of meat eating. It is evident in the sallow complexion, the bad breath, and the constant increase of chronic disease. The Englishman has stools like a dog."

Intestinal stasis, or constipation, is an essential factor in chronic toxemia. Constipation creates the favorable conditions that enable the "wild" bacteria to establish themselves in the intestine and become the dominant flora.

It is evident that one of the first things to be accomplished in changing the flora is to increase peristaltic activity. The neglect to do this was the most serious error in the Metchnikoff method. The idea certainly is not a new one. It has been in active use for ages. The sagacious clinical teachers of the early part of the last cen-

tury employed it as a routine measure that recognized few exceptions. An "opening purge," "unloading of the portal circulation" with calomel, blue mass, salts, sulphur, rhubarb and soda, senna, aloes, leptandrin or croton oil, were introductory measures considered essential in the treatment of all sorts of chronic ailments.

When stasis occurs either in the small intestine or the colon; that is, when the intestinal contents stagnate, opportunity is afforded for the growth and development of the invading bacteria which multiply with prodigious rapidity. It is evident, then, that by hastening the transit of the food along the intestine, and securing prompt discharge of unusable material and excreta from the colon, we shall employ the most effective of all possible measures for limiting the growth and development of pernicious bacteria in the colon. This is the most important means by which intestinal toxemia may be combated. It seems strange, indeed, that Metchnikoff should have overlooked this important fact. Unfortunately he was a biologist, not a clinician.

Constipation encourages the growth of infectious bacteria. When sufficiently numerous and virulent, these give rise to colitis. Colitis, if sufficiently intense, gives rise to adhesions, kinks, and diverticuli. These conditions still further aggravate the constipation, toxemia, colitis, and the over-distention of the right half of the colon. As a result, the ileocecal valve is made incompetent, infectious fecal matter is forced back into the small intestine, infections travel upward to the duodenum, the gall-bladder, the pancreas and

even the stomach, and thus multiply more and more conditions that create or aggravate intestinal toxemia.

Metchnikoff's great mistake was in imagining that Nature had blundered in giving man a colon, whereas man is the blunderer in putting his colon to a use for which it was never intended and neglecting to supply it with the conditions necessary for its proper functioning.

The importance of Metchnikoff's great discovery that the poison-forming germs in the colon are man's most dangerous and insidious enemies, is not at all depreciated by the professor's untimely and premature death. The mountain of facts which the savant amassed in support of his views still stands unimpeached. He erred in not adducing from his premises the very evident practical conclusions to which they pointed. In this his learned pupils and former assistants, Doctors Tissier and Distaso, advanced beyond their master.

Metchnikoff placed the whole world under obligation to him for all time in his discovery that the flora of the human intestine needs changing. He pointed out one means of accomplishing this life and health saving change. He succumbed prematurely himself, perhaps because he failed to recognize the most efficient, obvious and practical of all means of combating intestinal putrefaction, namely, increased intestinal activity.

Milk the Most Remarkable of Foods*

Milk differs from every other food substance known in the fact that it is a complete food. If, in the case of adults, it needs to be supplemented by other foodstuffs, cow's milk is for the young infant, when properly modified, a perfect food. It contains in excellent proportions, all the elements needed by the growing child. This is not true of any other substance known.

The fuel element is represented in milk by fat and sugar of milk. The fat is of a sort easily utilized by the body.

Why Milk Sours While Meat Putrefies

The sugar of milk is a special product exactly adapted to the needs of the body, far superior to cane sugar and free from the unwholesome properties of the products of the sugar cane. It is found nowhere else in nature except in the milk of animals. Milk sugar is slowly digested and is absorbed only one-fourth as rapidly as malt sugar. This enables it more easily to reach the lower intestine where it is converted into lactic acid and so prevents the putrefaction to which

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* Abstract of an address delivered by request of the New York State Commissioner of Agriculture before the State Dairymen's Association, of New York, at its annual meeting at Syracuse, 1916.

modern science has traced a great number of the maladies of both infants and adults.

It is due to the presence of lactose that milk sours while meat putrefies. Nearly ten years ago, I placed in a jar of buttermilk a raw beefsteak to which no antiseptic of any sort had been added. The beefsteak is still intact, thanks to the antiputrefactive properties of milk sugar and the acid-forming bacteria it feeds. The reason for this antiputrefactive property of milk was discovered by Kendall of Harvard, who a few years ago demonstrated that in the presence of sugar even highly active putrefactive organisms produce harmless acids instead of noxious toxins and ferments. This is certainly a most beneficent provision of nature whereby the normal food of the young infant is kept in a wholesome state while undergoing the processes of digestion and absorption in the intestine.

In the casein of milk is found material for growth and repair, and in a form favorable for prompt and complete digestion and assimilation. There are also other proteins in milk which serve the same purpose.

Milk Rich in Salts

Cow's milk is also rich in salts, containing four times as much of these mineral elements as does mother's milk. Milk is particularly rich in lime. A pint of milk contains 11 to 16 grains of lime, more than is found in a pint of lime water. Note the contrast in this regard between milk and beefsteak, or flesh food of any

sort. Meat supplies only half a grain of lime to the pound, although containing twice as large an amount of solids as does milk. The reason for this is obvious. Milk is a substance provided by nature as an exclusive food for a growing animal, and so must furnish lime for the bones as well as protein for the muscles. Meat represents but a fraction of the original foodstuffs. When corn or other food is eaten by an ox, the several elements are separated, each going to form its own tissues—fat to fat, protein to muscle, and lime to the bones. So to get back the whole assortment of food principles fed to an animal, one must eat its entire body, the whole ox, or the whole hog, bones and all. This being impossible, kind Nature has supplied us in milk with bones, muscles, brains, nerves, every bodily structure in solution, and in attractive form, a most delectable and tempting nutrient unsurpassed by the daintiest products of the culinary art, or any achievement of chemical knowledge and skill.

Milk Rich in Vitamines

Another notable quality of milk is its richness in vitamines. In this respect also milk is unique and superior to all other foodstuffs. Of ordinary foodstuffs each provides its own sort of vitamines. These remarkable and magic working substances are, according to Funk, the discoverer, produced only by vegetables. Each plant produces its own sort of vitamines. The vitamines of milk are not produced by the cow,

but only collected by her. As she browses about the pasture she selects the various sorts of grasses, twigs, leaves and stems which suit her needs and with them gathers a fine assortment of cell-stimulating, life-saving vitamines which are borne by the glistening streams which pour from her udder and impart to this wonderful foodstuff a potency as a body-building agent possessed by no other known substance.

It should be mentioned right here, however, that these remarks are true only of clean cow's milk as it flows from the original fount, and do not hold for milk which has been boiled or pasteurized, or doped with alkalies, which several processes destroy the precious vitamines and deprive the milk of one of its most unique and valuable properties.

Fresh Milk a Live Food

But there is something more to be said of the food properties of this fascinatingly interesting product of maternal providence. Milk is a live food. Of course it is not alive in just the sense in which a growing animal or a plant is alive, but still it possesses certain properties which are peculiar to living things, and which serve the body in a most remarkable manner.

The Digestive Ferments of Milk

Milk contains certain digestive enzymes or ferments, galactose, oxidase, and reductase which aid the processes of digestion. It is important to note, however, that this is true only of fresh

milk which has not been sterilized by boiling. These useful ferments, like the subtle vitamines, are destroyed by heat. This may be easily shown by a simple experiment known as Storch's test for heated (boiled) milk. Shake five c. c. of the milk in a test tube with one drop of 2 per cent. hydrogen peroxide and two drops of 2 per cent. sol. paraphenaleine-diamin. If the milk has not been heated, a dark violet color appears at once, but if it has been pasteurized or boiled, no color appears.

The Antitoxins of Milk

There still remains a final word to be said about the wonderful properties of fresh cow's milk. Milk is a sort of fluid tissue and like other tissues is prepared from the blood; hence it is not surprising that the profound scientific study to which this remarkable food substance has been subjected within recent years has brought to light the fact that milk possesses some of the properties of the living blood from which it is produced. While still warm with animal heat, freshly drawn milk, like the blood, possesses the power to combat and destroy germs. Milk contains various anti-bodies which are found in the blood, aglutinins, antitoxins and opsonins. It must be admitted that these last named elements of milk have been so recently discovered that their relation and value to human life and health are not yet fully understood. It cannot be doubted, however, that future researches will show their function to be important, and there

is ground for believing that they may play a part of some consequence in preparing and maintaining the defenses of the body against disease.

In order that milk shall fill the important place as a nutrient which its natural properties render possible, it is essential that certain conditions respecting its use should be complied with.

Injurious Effects of the Sterilizing or Pasteurizing of Milk

Milk should be alive, or at least uncooked. Pasteurizing, that is, heating to a temperature of 158 degrees Fahrenheit, destroys the antibodies of milk. When the milk is heated to a temperature of 176 degrees Fahrenheit the digestive ferments which it contains are destroyed. The boiling of milk modifies in a harmful way nearly all its ingredients and considerably reduces its nutritive value. Rats fed on boiled milk grow to only half their normal size. Scurvy sooner or later appears in babies exclusively fed on pasteurized or boiled milk. The subtle alchemy by which milk is prepared in the laboratory of Nature is upset by the crude process of cooking. Boiled milk will sustain the life of rats but it will not enable them to grow to full development, and reproduction fails altogether. Science is teaching us every day that the fine adjustments and adaptations of nature cannot be safely ignored. We are gradually learning through the loss of millions of lives which have perished through our ignorance, that the foodstuffs which nature designed for our use are

not the haphazard products of wild and incoherent forces but are wrought out by a subtle and infinite wisdom which fits them to our needs so perfectly as to transcend our highest knowledge and defy the profoundest analysis.

Another defect of the pasteurizing process is found in the fact that it is not absolutely certain.

Another matter of much significance which must be borne in mind in relation to pasteurized milk is the rather surprising fact that, if not handled with very great care, pasteurized milk is likely to develop within a short time more bacteria and bacteria of a more dangerous type than are found in ordinary raw milk. The reason for this is that most of the bacteria found in ordinary raw milk are of the acid-forming sort; that is, they are of the kind that are commonly known as buttermilk or sour milk germs, so-called friendly or protective germs. So long as these bacteria are dominant, the growth of putrefactive germs in the milk is prevented. These acid-forming germs are destroyed by the pasteurizing process, but the spore-forming putrefactive organisms are not destroyed and hence grow with greater facility in milk which has been pasteurized than in milk which has not been pasteurized.

It is evident that pasteurization does not solve the milk problem. When scientifically done, pasteurization does mitigate some of the evils associated with unclean milk but the only true solution for the problem is clean milk.

Man has been defined as a "cooking animal" and for ages the culinary art has been highly

cultivated and made the means not only of utility but of harmful luxury. Through modern scientific research, we are coming to know that notwithstanding its great service to the human race, the art of cookery has associated with it many perils, one of the greatest of which,—the most recently recognized,—is the fact that it destroys the vital elements and so modifies the food as to greatly impair its nutrient value. The beasts of the forest, and to a large extent also the primitive savage, take their food directly from the hands of nature, unsophisticated and uninjured, and as a result enjoy an immunity from disease and acquire a vigor and toughness of constitution which are unknown to civilized man. The chef of the future will display his finest talents, not in the compounding of complex combinations of foods with non-foods and poisons, into disease-producing entrees, ragouts and dyspepsia-breeding desserts, but in selecting and serving in wholesome and attractive ways the pure products of nature's great food laboratories—the garden and the farm.

Milk, fresh from the bovine fount, with its rich store of vitamines and enzymes, with the finest quality of protein for brain and muscle building, salts to stiffen the boney frame-work and fats to brighten the vital fires of the body, is a natural product which not only is not improved by the art of cookery, but is actually damaged by it and rendered unable to supply those subtle elements which are, we now know, so essential to good nutrition.

Milk Must Be Clean

The chief reason assigned for the pasteurizing or sterilizing of milk is the presence in the milk of large or small quantities of filth which should have been left in the stable or the barnyard. Combe and others have shown that the germs associated with this putrefying filth are the most prolific source of diarrheas, and other intestinal disorders which annually carry off so many thousands of infants during the summer months. These same putrefactive germs are likewise the cause of intestinal toxemia or autointoxication.

Infection Due to Unclean Milk

Milk must be free from the germs of disease. In addition to the common organisms which give rise to putrefaction and with which the milk becomes contaminated through careless dairy methods, milk may contain germs of various specific diseases such as tuberculosis, typhoid fever, diphtheria, scarlet fever, sore throat, malta fever, maladies originally derived from human beings suffering from the above named disorders and with the germs of which the milk, by direct or indirect contact, becomes contaminated.

Milk may also communicate to human beings various disorders which originate in cattle, but which may be communicated to human beings by making use of the milk of sick animals, such as foot and mouth disease, milk sickness, gastroenteritis, anthrax, cowpox, rabies, actinomycosis and perhaps other maladies.

Infected Milk a Cause of Tuberculosis

Modern research has shown that bovine tuberculosis is communicable to human beings. According to Rosenau, it must be conceded that not less than 5 to 7 per cent. of all cases of human tuberculosis are due to infection from the use of infected milk or the flesh of tuberculous animals. In other words, more than 70,000 persons suffer annually from infection with tuberculosis through the use of the milk of infected cows.

A careful examination of the mortality tables published by the United States Census Bureau shows that not less than 3,000 children die annually as the result of infection with bovine tuberculosis, and not less than 60,000 children are constantly suffering from bovine tuberculosis contracted chiefly through the use of diseased milk.

The New Jersey Tuberculosis Commission found 16 per cent. of the dairy cattle in that state suffering from tuberculosis. In some parts of Germany 30 per cent. of all the cattle were found to be infected with this disease. An investigation made of the milk supply of the District of Columbia showed that 15 to 25 per cent. of all the cows furnishing milk to that community were suffering from tuberculosis.

Tubercle germs are not readily killed by dairying processes. Schroeder killed guinea pigs by infection with germs found alive in butter five months after it was churned. Tubercle germs have been found in great numbers in cheese and ice cream. Morgenroth even found

tubercle germs in nine out of 20 samples of oleomargarine purchased in the open market.

The public has been taught to place too much faith in sterilized or boiled milk. It is true that pasteurization or boiling of milk, destroys certain specific disease-producing organisms such as those of typhoid fever, tuberculosis and diphtheria, but these processes at the same time destroy certain highly essential, vital properties of milk, but as already pointed out, fail to destroy the spores of putrefactive organisms, which probably are, on the whole, the cause of far greater mischief and many more deaths than the organisms which give rise to tuberculosis, typhoid fever and other specific organisms. If left to itself, raw milk does not decay but sours. Boiled milk rots. The acid-forming organisms which find their way into the milk from the air thus exercise a protective influence, preventing the toxemia which results from intestinal putrefactions. When an infant is fed upon sterilized milk, the stools, which are naturally slightly acid, quickly become foul smelling through putrefaction and the infant is thus exposed to highly potent disease-producing influences against which it is protected when fed upon natural, clean milk. A temperature of 240 degrees for half an hour is required to destroy the spores of putrefactive germs and even such milk is likely to promote putrefactive processes in the intestine, especially in the case of young children. It is thus apparent that pasteurization and boiling of milk should be regarded only as makeshifts which mitigate to some degree the evils

resulting from the use of milk contaminated with barnyard filth but are not by any means a substitute for clean natural milk.

How to Eat Milk

Milk must be eaten, not swallowed as a beverage. It must be chewed. All foods need to be masticated. The calf and the nursing infant chew the milk which they draw from the maternal font. The movements of the jaws and the sucking movements executed by an infant in nursing induce an abundant flow of saliva which, mixing with the milk, properly dilutes it, and to a high degree promotes its digestion. Milk when swallowed rapidly as a beverage is likely to form in the stomach large and hard curds which are very slowly digested. Many persons who suffer from taking milk in this way imagine themselves to be unable to take milk and so abandon its use. I remember a man to whom I had recommended the liberal use of milk. He protested that he was absolutely unable to use it at all and stated that on the last occasion on which he had taken milk he had nearly lost his life. A few hours after hastily swallowing several glasses of milk he experienced a sensation of suffocation, was then nauseated and on attempting to vomit experienced a choking sensation. On reaching his finger down his throat he felt a mass which he seized and to his astonishment drew out a rope of milk nearly a yard in length. The milk had formed in his stomach one large, hard curd which he was certainly very fortunate in being able to get rid of so easily. The famous

English surgeon, Dr. Lawson Tait, told me of a case in which he was obliged to perform a surgical operation to remove a similar mass of curds which had lodged low down in the intestine.

Milk should be sipped slowly and with a sucking movement or taken through a straw so as to secure a liberal admixture of saliva. By this means the formation of hard, indigestible curds may be prevented.

Milk must be taken in right quantities and in right combinations. It cannot be denied that milk digests better when taken by itself or in very simple combinations than when mixed with a large variety of other foodstuffs. In some instances, also, a large quantity of milk is more easily digestible than a small quantity. When the stomach produces a large amount of highly acid gastric juice, as is usually the case with persons who have been accustomed to a hearty meat diet, the curds formed when a small amount of milk is taken will be large and tough, whereas if a larger amount of milk is taken, the curds formed will be smaller and softer. Hence, the proper remedy in many cases in which a person complains that he cannot take milk, is to take more milk.

As already remarked, the taking of milk with meat is perhaps the worst of all dietetic combinations. The reason for this was made clear by Pavlov, the eminent St. Petersburg physiologist, who showed that meat requires a highly acid gastric juice for its digestion and that the stomach produces this sort of juice when meat is eaten, while milk demands a juice low in acid.

When milk is largely used as a nutrient, the balance of the diet should consist chiefly of fruits and vegetables for the reason that milk contains an excess of lime and is deficient in potash and soda which are necessary for perfect human nutrition. The last named elements are abundant in fruits and vegetables, particularly in the potato, which is also very rich in salts of potash. A diet consisting exclusively of milk and cereals is less satisfactory. Such a diet often gives rise to scurvy in infants. Cereals are deficient in the alkaline elements which are needed to neutralize the acid products developed in the body.

In the use of milk, it is well to remember, also, especially when it is freely taken, that one may easily by this means ingest an excess of fats. The milk of certain breeds of dairy cattle is exceedingly rich in fat. The use of such milk in some persons, and especially in infants and young children, gives rise to symptoms which are sometimes denominated as biliousness, but which are not directly connected with the liver, being due to putrefactive changes set up in the intestine by the presence of an excess of fat. Breeders of dairy cattle have labored to produce strains of milch cows which produce milk containing a large amount of fat because they are more profitable, but for table use, milk containing a smaller proportion of fat is much to be preferred. It may be on this account, as suggested by Rosenau, that the milk produced by the Holstein cow is much better adapted to the human stomach than is that of breeds which

produce milk containing a much larger proportion of butter-fat.

Modified Milk

When employed in artificial feeding of infants and in some cases in the feeding of invalids, cow's milk must be especially modified. Ignorance of this fact and of the proper method of feeding milk is responsible for the death annually of a great multitude of artificially fed infants. Of the 2,500,000 infants born in the United States annually, not less than 250,000 die as the result of improper artificial feeding. The mortality of bottle-fed infants is more than four times that of breast-fed infants. Cow's milk differs very decidedly from mother's milk. It contains four times as much lime and three times as much protein and only about two-thirds as much sugar. Protein and fat are the elements of cow's milk which are the greatest source of trouble to the human infant. Each animal produces milk exactly adapted to its own young, calculated to promote the development of its digestive organs in a normal way. The milk of the whale and the seal contains 50 per cent. of solids and an enormous proportion of fat which the young whale needs to protect it in the icy waters in which it lives. Cow's milk contains a large amount of protein and lime to support the rapid growth of the calf which attains puberty at the end of two years, about one-seventh of the time required for the human infant to reach the same stage of development.

Best Formula for Modified Milk

Various formulas have been devised and recommended for the modification of cow's milk in artificial feeding. The most of these are more or less complicated. Recent experience has shown that a very simple method is much superior to the complicated measures which have been developed. It is only necessary to add two things, water and milk sugar or malt sugar, to render cow's milk suitable for the use of very young infants. A good formula is equal parts of full milk and boiled water with an ounce of malt sugar for each pint of water added to the milk.

A Person May Be Sensitized to Milk

Another point to which attention should be called in the interest of both infants and invalids is the fact that certain persons become sensitized to milk as well as to other forms of protein, and to a person who is sensitized, even the smallest amount of milk gives rise to highly poisonous and even fatal symptoms. Many infants die annually from this cause. This fact should be borne in mind in changing the infant from the breast to bottle feeding. The milk should first be given in very small quantities, a teaspoonful in a half glass of water, the proportion being gradually increased until the proper dilution is reached. The same method should be pursued with individuals who have learned by experience that unpleasant symptoms are noted after the use of milk. The adult or infant who

is sensitized to milk may be cured by the administration of milk in graduated proportions, beginning with extremely small doses. Such a case requires the personal care of a physician.

Medical Uses of Milk

Milk is not only useful as a nutrient for healthy persons, but by proper management, may be made to play a highly important rôle as a curative agent. For example, there is no better means of inducing a rapid gain in flesh than by milk feeding. There are many other medical uses of milk in the form of the milk regimen.

Again, the free use of milk is a useful, almost a necessary remedy for the lime starvation which, according to Prof. Sherman of Columbia University, is coming to be almost universal in this country, and is doubtless largely responsible for the early decay of the teeth noted among American children.

Milk Ranks High as an Economic Food.

Ten cents will buy in the form of milk more than twice as much food as in the form of beefsteak, nearly 10 times as much as in the form of oysters, and 3 times as much as is supplied by 10 cents worth of eggs, so that milk is really by far the cheapest of our ordinary animal foods.

When we consider the amount of tissue building material which may be produced on a given area of land, the economy of milk as a foodstuff becomes still more apparent. According to Professor Henry, late Dean of the agricultural

department of the University of Wisconsin, 100 pounds of food, when fed to animals, produces the following quantities of actual foodstuff:

Milk	18 pounds
Eggs	5.6 pounds
Beef	2.8 pounds
Mutton	2.6 pounds

It is evident from the above that the cow is more than six times as efficient a food transformer as is the steer. Feeding corn to steers wastes ninety-seven per cent of the corn.

The Special Value of Milk Proteins

In recent years chemical researches and very remarkable feeding experiments conducted by Mendel and Osborne, McCollum and others have demonstrated that there are great and essential differences in proteins. It is found that albumen, casein and other proteins are not simple substances but are compounds of simpler substances (Amino-acids) which are termed "building stones." Each protein differs from every other in the number of kinds of the building stones which enter into the composition. About twenty of these simpler bodies are required for building the body proteins.

All of these are found in certain food proteins, while some are lacking in others. Proteins which contain all the needed "building stones" are known as "complete proteins."

The foodstuffs which contain complete proteins are nuts, milk, eggs and meat. The pro-

teins of fruits, grains, roots and green vegetables are incomplete proteins and must be supplemented by the complete proteins to render them capable of meeting the body requirements.

McCollum considers milk of greater importance than meat in the national bill of fare and attributes to milk rather than meat the physical superiority of certain meat-eating nations. This writer calls especial attention to the fact that meat-eating nations are also milk-eating. In view of this highly interesting result of recent scientific inquiry it is evident that the dairy interests of the country should be encouraged rather than beef and pork production.

Nuts and Nut Milks

Primitive man no doubt obtained his "complete proteins" from nuts as the higher apes still do, and those who are sensitized to milk or other animal proteins will find in nuts and nut milk a perfectly satisfactory source of protein nutriment.

Hoobler has recently shown that nursing mothers on a diet in which nuts are substituted for animal proteins produce more milk than on any other diet and are themselves better nourished. Many young infants found to be sensitized to cow's milk have been successfully reared on nut milk.

Evidently persons who exclude milk, meat and eggs from their dietary should make nuts a regular and substantial part of their daily fare. The proteins of the soy beans are also "complete" proteins.

The Rice Regimen

For many years the writer has realized the great value of rice in certain pathological conditions. In the Southern States, particularly in Louisiana, an exclusive rice diet for a few days is the popular remedy for indigestion due to over-indulgence of the appetite.

Dr. H. D. Bulkley, the famous skin and cancer specialist of New York City, has for many years recommended a rice diet as almost a specific for eczema and certain other forms of skin disease. In the writer's experience, rice is a most valuable food remedy in conditions in which there is marked irritation of the buccal or gastric mucous membranes.

A study of the composition of ordinary polished rice shows it to be chiefly composed of carbohydrate, a starch consisting of very small granules which are easily broken up by cooking and are very readily digested.

The protein content of rice is small, only nine per cent, but the protein is of unusual value, much superior to that of other cereals.

The proportion of fat in rice is very small, only one per cent of the raw material, and less than one-third of one per cent in cooked rice.

Rice also differs from other cereals in the very small amount of mineral salts which it contains. It contains very little lime and iron, and an extraordinarily small amount of potash as com-

pared with other cereals and most other vegetable foodstuffs.

When cooked in such a way as to break up the individual grains, rice forms a very smooth, emollient purée or gruel which is so bland and unirritating it produces no smarting or other unpleasant sensation when brought in contact with raw surfaces, as does almost all other vegetable foodstuffs because of acids, potash salts or other irritating substances present.

For rice feeding, very little salt should be added in the cooking, and no other seasoning. The rice may be served simply boiled or steamed, or in the form of a purée or gruel, or as dry toasted flakes.

Care must be taken to cook the rice very thoroughly, an hour at least, and in general the cooking grain should be well stirred so as to reduce it to a smooth, soft consistency.

The energy value of an ounce of dry, uncooked rice is 100 calories. Boiled rice is two-thirds water. The food value per ounce of gruels, purées, and other preparations may be easily calculated by noting the weight of the raw rice and the cooked product, multiplying the former by 100, then dividing by the latter. Suppose the raw material weighs two ounces and the purée made from it, ten ounces; we have $2 \times 100 \div 10 = 20$. That is, each ounce of the purée represents 20 calories. It will be easily seen that the nutritive value of such a preparation is small, a little less than that of milk, and so several quarts are required to furnish a full day's ration even for a bedfast patient. One pint

would supply 320 calories, and for 1600 calories, five pints would be required. Such a ration should be taken in four or five meals to avoid overloading the stomach.

In general, it is admissible to add a little cream or sweet sterilized butter to the rice to increase its palatability, but in cases of extreme irritation, only a little salt should be added for seasoning; much salt should be avoided.

In long-continued rice feeding, special care must be taken to encourage bowel action. If this is neglected, great injury may be done. The rice is so completely digested and absorbed, practically no residue is left, and the result is stasis in the colon and an accumulation of bile, mucus, and other intestinal secretions which readily undergo putrefaction. This is shown by the appearance of indican in the urine, and headache and other unpleasant effects are likely to occur.

If the bowels are kept active, moving three times a day, putrefaction will not occur, and indican will not appear in the urine. This may be accomplished by the free use of agar or bran and paraffin oil. The best results are obtained with heavy preparations of paraffin which melt at the temperature of the body and with mixtures of bran and agar. When great irritation is present, agar is sometimes preferable to bran, although bran is ordinarily not irritating, as is commonly supposed. Wet bran is like wet paper, and is no more irritating to the stomach and bowels than to the mouth.

It must be remembered that both bulk and lubrication are needed to secure efficient bowel

movement. That is, both oil and bran or agar must be used, and in sufficient quantity to secure three good bowel movements daily. The usual amounts needed are three to six ounces of oil and one ounce of bran and half or three-fourths of an ounce of agar daily. These amounts may be doubled if necessary to secure three daily evacuations.

When with a rice diet the stools are foul smelling in spite of three evacuations daily, the fact is evidence that the movements are insufficient, that is, they do not fully empty the colon. There is, probably, dilatation of the cecum or adhesion of the cecum or appendix with retention and putrefaction of feces. This condition requires the habitual evacuation of the colon every night by a large warm (102° F.) enema,—three or four pints of warm water,—followed by two pints of water at a temperature of 80°-85° F.

If for any reason it is found necessary to avoid all solid food for a time, the bran and agar may be omitted and an enema should be given at least twice a day so as to keep the colon empty. Paraffin oil should be used in all cases.

For good results with the rice diet all these directions must be followed with scrupulous care.

The Technic of the Rice Regimen

The day's ration may be taken at three meals or may be divided into a number of small meals taken at intervals of two or three hours, as may be indicated in individual cases.

When the diet is continued more than a day or two, it is important to make sure that the quan-

tity of food taken is sufficient to sustain the patient. If the patient is in bed, sixteen to eighteen hundred calories will accomplish this. This will require the consumption of five or six pints of purée consisting of one part of rice to five parts of water, twice the quantity of rice gruel, or four pounds of ordinary boiled rice.

In most cases, the caloric value of the feedings may be increased by the addition of perfectly fresh sterilized butter in the proportion of one-half ounce to the pint of gruel or purée. This will give to each pint of purée a value of four hundred and fifty calores, which at four feedings of one pint each would furnish a day's ration.

A nut cream prepared from blanched almonds is also an excellent means of increasing the energy value of the feedings. In many cases cream or milk may be added. The average value of the milk is about twenty-one calories to the ounce, or practically the same as rice purée. Ordinary cream has an energy value of fifty calories per ounce.

It must also be remembered that rice is almost wholly lacking in iron and lime. For this reason it must be supplemented with purées of greens in cases in which the rice feeding is long continued. Otherwise the body will lose lime at the rate of ten grains a day and iron at the rate of one-fourth of a grain daily, at which rate the body would lose in six weeks nearly one-fourth of its entire iron content. Five or six ounces of spinach or three or four ounces of wheat gluten in place of an equal quantity of rice will be sufficient to equalize the diet in both lime and iron.

APPLICATIONS OF THE RICE REGIMEN

The rice regimen is especially adapted to cases in which a high degree of irritation exists in the mouth, the stomach, or the small intestine. Among the conditions in which the writer has found this regimen of signal service are the following:

Injuries and Acute Inflammation of the Mouth

In cases in which the mucous surfaces of the mouth or throat have been injured by the contact of hot liquids or chemical substances, rice gruel daily will be found exceedingly useful. This bland food causes no irritation by contact with the sensitive raw surfaces. A gruel tube should be used for the feeding which may be given at intervals of three or four hours or in large quantities three times a day. After each feeding the mouth should be rinsed with warm water containing a teaspoonful of salt to the pint.

Rice feeding is also advantageous in mumps.

Gastritis

In cases of gastritis, rice gruel may be taken in quantities of four to eight ounces at intervals of three or four hours and will be well retained when almost any other food will produce nausea and vomiting. In general, rice gruel will be found to agree very much better than milk in any form, although the addition of a small amount of yogurt buttermilk, say 20 per cent, will often be found to be advantageous, and will

hasten recovery by combating the pathogenic bacteria with which the stomach is infected. As the stomach becomes less sensitive, the amount of yogurt buttermilk may be increased from day to day until it constitutes half or two-thirds the bulk of the food given. When there is very marked irritation, it is sometimes necessary to begin the feeding with teaspoonful or tablespoonful doses. When the feedings are so small, they must be often repeated.

Gastric or Duodenal Ulcer

In cases of gastric or duodenal ulcer, rice gruel often renders signal service not only on account of its bland character, but also because of the favorable influence of a carbohydrate diet upon the acid-forming glands of the stomach, as first pointed out by Pavlov of St. Petersburg. The addition of a little sterilized butter or olive oil in the proportion of a teaspoonful to the pint of gruel, has the effect to still further inhibit the production of acid and will be found highly beneficial. In extreme cases the gruel should be given in tablespoonful doses at intervals of an hour or two and should be kept cold by putting the vessel containing it in a larger vessel containing ice.

Gastric Spasm

Modern physiologic researches in relation to the gastric fuctions have shown that pain in the epigastrium (pit of the stomach), when no lesion of the stomach can be discovered by means of the X-ray, is generally due to exaggerated contrac-

tions of the stomach with spasm of the pylorus, due to disease of the gall bladder or some lesion of the intestine below the stomach. In the writer's experience, pyloric spasm, whether due to disease of the gall bladder or ulcer of the duodenum, generally may be relieved by the taking of four to eight ounces of rice gruel prepared with a little butter or olive oil and little or no salt.

Pyloric spasm and epigastric pain often occur early in the morning, and for this reason it is well to advise such patients to have ready at hand a quantity of rice gruel kept warm by means of a a thermos bottle.

Post-Operative Feeding in Cases of Gastric Surgery

In cases of complete or nearly complete pyloric obstruction of long standing, it is often necessary to begin feeding at the earliest possible moment after the operation of gastroenterostomy or the Polya operation on account of the extreme weakness of the patient. The contact of rice gruel with the raw surfaces in the stomach produces no irritation. The gastric glands are very little stimulated by the bland liquid in contact with them and so no excess of gastric juice is formed. For these reasons rice feeding is very useful in these cases.

It is true that in most cases of gastric surgery no serious injury results to the patient by a fast of three or four days, as required by most surgeons, but in the writer's experience, fasting is not necessary provided no food but rice gruel or

some equally bland liquid is given. The gruel, being sterile and bland, serves as an emollient for the raw surfaces in the stomach and the small amount of gastric juice developed acts as an antiseptic, preventing putrefaction in the stomach and hindering the growth of pus-forming organisms. The feeding also has the effect to cleanse the stomach from the stagnant and putrefactive liquids likely to accumulate there because of the paralyzed condition of the stomach and the oozing of blood and serum from the more or less extensive raw surfaces. Certainly the condition of wound surfaces covered with sterile rice gruel must be much more favorable for healing than when the surfaces are submerged in the putrefying materials which are almost universally present in the stomach when no food is given for several days after operation. On this account it is the writer's practice to begin feeding the patient small quantities of warm rice gruel within a few hours after the operation in all cases in which nausea and vomiting are not present.

Feeding with rice gruel is also a useful means of relieving the gastric pain which sometimes follows operations upon the gall bladder, probably due to spasm of the pylorus.

Cancer of the Stomach

In cancer of the stomach when much gastric irritability is present, as is usually the case in the latter stages of the disease, and when obstruction is not complete, rice gruel and rice in other forms usually agrees better with the stom-

ach than any other food, and should be made the staple articles of diet. A mixture of bland greens, parboiled, so as to remove any oxalic acid which may be present, will aid in prolonging the patient's life by supplying food iron to promote blood formation. The rice regimen may be usefully employed in many cases of skin disease after two or three days of fruit regimen. In such cases, rice may be used very freely and in various forms, and should be accompanied by the free use of greens, bran, fresh vegetables and other bulk-producing foodstuffs.

A couple of pints of yogurt buttermilk may be used daily in cases in which sensitivity to milk does not exist. In cases in which milk does not agree, the yolks of eggs may be used in place of milk. Either eggs or milk should be used in such cases as a means of maintaining a normal supply of complete proteins.

The rice regimen may also be used in connection with the milk regimen especially near the end of the period of milk feeding and as a means of changing from the milk to the ordinary diet. When used for this purpose, the rice purée may be substitued for an equal quantity of milk, or milk may be added in increasing quantities to the rice gruel or purée.

Rice combines more readily with milk and fruit than almost any other article of food and may be occasionally introduced during a course of milk regimen for a day or two when the patient pleads for a change.

The Potato Regimen

Professor Hindhede of Copenhagen has for years been making experiments with potato feeding. In a letter received some years ago from Horace Fletcher, who was at that time at Copenhagen, the writer first learned of these potato experiments in some of which Mr. Fletcher served as a subject. He stated in the letter referred to that he had at that time lived wholly upon potatoes with the addition of a little butter, for six weeks and found himself in fine physical condition.

The writer later learned from Professor Hindhede of experiments upon other persons covering two years or more in which no food but potatoes had been taken with the exception of butter or some other form of fat.

A few months ago, Professor Hindhede informed the writer of another experiment conducted by him in which a young man had maintained vigorous health for twenty-three months while living on a diet consisting wholly of potatoes, bread and greens, the potatoes being the chief staple. No fat whatever or other food substance had been taken during a period of nearly two years.

An eminent European surgeon has recently published a research of extended observations in the use of the potato as an exclusive article of diet, particularly in cases of renal disease, in which good results were attained.

A gruel made from potato flour may be used in cases in which it is desirable to tax the digestive organs as little as possible while at the same time introducing a large quantity of alkaline salts to combat a tendency to acidosis which may be present.

Potato gruel cannot be used as a substitute for rice gruel for the reason that it lacks the bland, emollient character of rice, probably on account of the large quantity of alkaline salts present.

Bacterial Implantation in the Intestinal Tract

Three months after the publication of the first edition of this work, there appeared in the *American Journal of the Medical Sciences,* for August, 1918, a valuable article by Dr. Arthur I. Kendall, Professor of Bacteriology in the Northwestern University Medical School of Chicago, and Director of the Patten Research Foundation. We quote from this article the following paragraphs which the careful reader will see very strongly support the views and methods set forth in the foregoing pages of this volume:

"Somewhat more than a century ago, Metchnikoff published that very interesting but somewhat speculative book called *The Prolongation of Life,* in which he called attention to a possible parallelism between premature senility, that very indefinite condition spoken of as auto-intoxication and the possibility of microbic stagnation, leading to the overgrowth of bacteria which produced substances acting as cumulative poisons. To combat these somewhat hypothetical toxicogenic bacteria he proposed to infect the intestinal tract with lactic acid bacilli. Although many of the assumptions on which this theory was based have not yet received confirmation, the concrete idea of bacterial implantation within the intestinal canal for therapeutic purposes opened a new and interesting field for study.

"Very briefly the theoretical procedure was to introduce into the alimentary canal living cultures of suitable organisms which would colonize and through the formation of certain products—benign to the host but inimical to the bad microbes—restrict the activity of the latter or even drive them out. The organism selected for this purpose was *Bacillus Bulgaricus.*

"Observations made by different observers upon experimental animals have shown almost conclusively, however, that the *Bacillus Bulgaricus* does not acclimatize itself readily in the large intestine, where the microbic cesspool is most active. If published observations are correct, *Bacillus Bulgaricus* is an organism which for scores of years has been cultivated in milk outside of the human body. It requires a great deal of courage to predict that an organism which has been cultivated exclusively outside of the body in milk for many years should be able all at once to adapt itself to intestinal conditions, and it is not surprising to find that the implantation of *Bacillus Bulgaricus* has left much to be desired.

"There is, however, an organism, or, more properly, a group of organisms, relatively common inhabitants of the lower intestinal tract of man, which possesses the requisite qualifications for development within the alimentary canal, and inasmuch as they are normal inhabitants of the region where colonization is desirable, these bacteria would appear to be the logical candidates for this type of therapeutics.

"In order to be certain, however, that Bacillus

acidophilus (for that is the name of the organism) will colonize successfully and certainly within the intestinal tract the mistake must not be made of keeping cultures of this organism too long upon artificial media before introduction into the body. That is to say, the artificial perpetuation of a strain of Bacillus acidophilus for long periods of time outside the human body may so modify its adaptability to intestinal conditions that it will not fulfill the purpose for which it is intended. Fresh isolations from the intestinal contents should be made as frequently as is necessary to ensure an active acclimatizing strain. Failure to realize the importance of these relatively simple and perfectly obvious details has prevented the accumulation of a satisfactory literature upon the highly important practical aspects of bacterial implantation.

"In addition to the obvious necessity of securing a suitable microbe for intestinal bacterial therapeutics it is equally essential to provide the proper food for the organism. The food for the organism is naturally that portion of the intestinal contents flowing through the section in which the microbes are growing. If the object of intestinal implantation is to restrict the putrefaction of protein derivatives—and this is usually the object sought for—it is perfectly obvious that a decided reduction in protein in the diet is an important initial step. The next step is to increase the carbohydrate of the diet, but it is imperative to ascertain if the carbohydrate in utilizable form actually reaches the desired area. If, for example, the reduction in protein and

increase in carbohydrate is assured, but there exists a sluggish motility in the higher layers of the alimentary canal, the inevitable tendency is for the rather rapidly assimilated carbohydrates to be absorbed, leaving a residuum of protein derivatives, which are naturally hydrolyzed more slowly. Under these conditions, although the diet may appear adequate and correctly proportioned on the diet sheet, it may well happen that the amount of carbohydrate actually reaching the lower intestinal tract is so limited that the desired object of a continued supply of utilizable sugar is not realized. Enough has been said to suggest at least the nature of the factors which must carefully be considered before accepting or rejecting the efficiency of bacterial implantation.

"There are contra-indications to bacterial implantation and these may be theoretically of at least two classes. If the condition to be corrected is one which is associated with a relative intolerance for carbohydrates (and such conditions are not uncommon, although they are frequently not recognized), then clearly the administration of carbohydrate as such is not likely to be productive of the best results. On the other hand, there are occasional diarrheal conditions in the intestinal tract which are associated with, even if not caused by, an overgrowth of bacteria which are able to ferment large amounts of certain types of carbohydrate in an abnormal manner in a very short time. Some of these microbes, even in an artificial medium, may actually use up 5 per cent or more of sugar within a

period of a comparatively few hours. How much more active may these organisms be in the intestinal tract, where, generally speaking, conditions for their development may be much more favorable than in artificial cultivation! Experience has shown that under these two conditions, namely, where there exists an intolerance of carbohydrates and where there may be present an unusual number of fermentative bacteria in an active or latent state, which would act energetically upon a sudden increase in the carbohydrate in food, the best results are obtained by administering sour milk. Apparently, although proof is still lacking upon this point, the considerable amount of preformed lactic acid in well-soured milk spreads rapidly through the intestinal tract, because of the increased peristalsis which is usually a factor of such cases, and brings about chemical improvement, which may be rapid or slow, depending upon conditions. The organisms which exhibit unusual intestinal fermentative activity are, so far as is known at the present time, intolerant of lactic acid.

"From what has been said it must be obvious that in theory at least there is a very close relationship between the diet of the host and the nature, extent and type of bacterial development which takes place within the alimentary canal. When the diet is monotonously rich in carbohydrate, so that the entire tract is permeated, as it were, continuously with sugars, the natural tendency is toward a great increase of bacteria whose fermentative activities are prominent. The products of growth of these organisms are not

inimical to the host, as a rule. This is shown by the great preponderance of *Bacillus bifidus* in the normal nursling and the ability to encourage to a marked degree an aciduric flora in suitable experimental animals by carefully conducted feedings. When the diet of the host is so modified that there is no longer a preponderance of carbohydrate throughout the intestinal tract, then there becomes manifest a regional strata of microbes whose metabolism is accommodated to the ordinary fluctuations in diet. In those levels in which carbohydrate is not continuously present and from which it occasionally disappears, it is not surprising to find that bacteria which accommodate themselves with almost equal readiness to media, with or without carbohydrates, become prominent. This is shown by the remarkable increase in colon bacilli in the intestinal contents of adolescents and adults. From the ileocecal valve onward the presence of carbohydrates is usually irregular and the colon bacillus consequently thrives better because of its adaptability in this respect than does *Bacillus bifidus.*

"*Bromotology and Bromotherapy.* Certain theoretical therapeutic applications present themselves if the above observations are correct. Hundreds of experiments in artificial media have shown that the typhoid bacillus, dysentery bacillus and many other pathogenic bacteria produce substances akin to those characteristic of sour milk, when they are grown in the presence of utilizable carbohydrate, and products undoubtedly associated with the decomposition of proteins when carbohydrate is absent. In the case

of the diphtheria bacillus the cultures in utilizable carbohydrate contain no toxin, whereas those cultivated under parallel conditions in media without carbohydrate produced considerable amounts of very potent toxin. Would it not be logical, in intestinal infections, as, for example, in dysentery or cholera, to attempt at least to flood the intestinal tract with considerable amounts of suitable carbohydrates and thereby provide the necessary non-nitrogenous pabulum for these organisms? Unless conditions within the intestinal tract are fundamentally unlike those in artificial media (an improbable supposition because the carbohydrate under discussion is a distinct chemical entity), it is reasonable to expect that some of the nitrogenous products formed by these bacteria may then be replaced by lactic acid and similar non-toxic fermentative substances; in other words, create dietary conditions within the alimentary canal potentially like those of a normal nursling and confidently hope for an analogous bacterial response. Of course the damage which may have resulted from the growth of pathogenic bacteria prior to the change in diet cannot be undone, but there remains the strong theoretical possibility of reducing, or even preventing, additional harm through this shifting of the metabolism of the invader by the utilization of carbohydrates for energy, with the resultant formation of definitely benign products.

"It must be emphasized in passing that an occasional aberrant fermentative flora be not aroused to unusual activity by this change of diet. Fortunately, such cases are relatively uncommon

and readily controlled if they are recognized when the change is made.

"The researches of Coleman upon diet in typhoid fever have indicated that the high caloric diet, relatively rich in carbohydrate, does exert an influence upon the patient which is not fully explained on the assumption of sparing the nitrogenous loss of the body, due to the fever and toxemia. The reduction in toxemia which is frequently observed will be explained in part at least by an absorption of carbohydrates from the intestinal tract, providing thus not only in the intestinal tract but in the tissues and blood as well a maximum amount of utilizable sugar. The tissues of the body are not called upon to furnish their own fuel. The normal blood contains not far from 0.08 per cent of dextrose. A large carbohydrate intake would tend to keep the glycogen reservoir in the liver and possibly other organs at a high physiological level. The relatively small amount of dextrose used by the bacteria within the tissues would thus constantly be replaced. Coincidentally, the reduction of putrefaction and the accumulation of lactic acid formed not only by the pathogenic bacteria, but by normal intestinal microbes as well, would tend to lessen rather than to increase irritation from bacterial products formed within the alimentary tract. Coleman and his associates have actually found that the beneficial effects of feeding on this high caloric diet were rather more marked in those individuals whose intestinal tracts contained active members of the aciduric group, and they have reached the conclusion that

an artificial implantation of *Bacillus acidophilus* may well be an important adjunct in the high caloric dietary treatment of this disease. The intestinal group of diseases, typhoid, dysentery, paratyphoid and cholera, would all appear to be amenable to this form of bromo-therapy.

"An hypothesis or theory developed in a growing subject which does not suggest more than it answers is a poor one indeed. In conclusion, therefore, a theoretical extension of the intro-intestinal aspects of bacterial metabolism, bacterial implantation and bromo-therapy to abdominal, intestinal and rectal surgery may legitimately be considered. It is a matter of rather common observation that perforating wounds of the upper intestinal tract are, on the whole, less dangerous to the patient than similar lesions lower down. Various explanations have been advanced to explain this phenomenon, and emphasis has been placed upon the comparative paucity of microbes in the duodenum and upper stretches of the intestines. This is apparently true during interdigestive periods. There is, however, a rapid rise in the number of bacteria when food enters the upper levels which would indicate that the kinds of organisms or their activities might be of some importance as well.

"From the viewpoint of alimentology it is an assured fact that carbohydrate will normally be present in the duodenal sector as the food passes through, and it is not surprising to find that the duodenal flora is, on the whole, relatively carbohydrophilic. The theoretical possibility of inducing a similar condition throughout the tract is in

the realm of possibility, as is clearly shown in that great natural experiment in the nursling's alimentary canal. The two important factors to be considered in inducing an appropriate intestinal flora as a preoperative measure are, diet and, in the lower intestine, bacterial implantation. It should be possible to assist the dietary factor materially in those instances in which carbohydrates in appropriate amounts do not reach the desired level by rectal administration, and this process readily admits of a simultaneous implantation of bacteria to assure a nucleus of desirable microbes upon which to build. Such a procedure can do no harm and the possibilities are decidedly in favor of the patient. If this is successfully carried out the dangers from intestinal infection should be materially lowered, a point of some theoretical importance to the surgeon.

"*Summary.* 1. There appears to be an intimate relationship between the character of the diet and the nature of the intestinal flora.

"2. This relationship, bacterially considered, is manifested by an adaptive intestinal acclimatization of fairly definite types of bacteria. Changes in the diet, if prolonged, tend to change the types of bacteria. A change in the products of metabolism of intestinal bacteria is also induced, depending upon the presence or absence of carbohydrate. Positive implantation of adventitious microbes—those not accommodative to intestinal conditions—appears to be infrequent.

"3. Bacteria which are normally acclimatized do not produce metabolic products widely at variance with the well-being of the host. Toxic or

irritating metabolic products tend to arouse the antagonism of the host. The results may be disease, expulsion of the microbe, immunity or the carrier state.

"4. Products arising from the utilization of food for energy by intestinal bacteria are of paramount importance in determining the specificity of action of these microbes. To a limited degree a careful modification of the diet may materially alter the character of these metabolic products, with benefit to the host. Bromotherapy may be practiced in acute or chronic disease.

"5. Bacterial implantation within the alimentary canal must follow natural lines. Bacterial acclimatization and adaptation is the resultant of complex reciprocal activities between host and parasite.

"6. Intelligent bacterial implantation presupposes an accurate knowledge of the chemistry of the metabolic products of the bacteria under varying dietary conditions.

"7. It is unwise to generalize from incomplete data. The data of bromatology and bromatherapy in relation to microbic activity in the alimentary canal are conspicuously incomplete. Nevertheless, the remarkable influence of diet upon the activities of intestinal bacteria, in so far as it is known, would warrant the assumption that a new chapter in the broad field of bacteriology has just opened. The indications are apparently favorable for a new avenue of approach to bacteriotherapy."

Any reader who is at all familiar with the facts and methods of modern bacteriology, will read-

ily recognize in the above paragraphs a complete justification of the therapeutic methods set forth in the foregoing pages.

It is not a little gratifying to the author to find theoretical bacteriology so completely in harmony with the practical results obtained in the treatment of some thousands of patients by the methods described, especially by the use of the "Fruit Regimen" and the "Milk Regimen."

These methods have been employed systematically in the treatment of patients at the Battle Creek Sanitarium as a means of "changing the intestinal flora," and with most gratifying success. Scores of physicians as well as thousands of other patients have received the treatment and have become converts to the method, and the author dares to hope that the new regimens described in this volume, or at least the principles upon which they are based, may become an established feature of the medical dietetics of the future.

Autointoxication the Cause of Goiter in Pigs.—Marine has shown (*Journal of Biological Chemistry,* Feb. 1918) that constipation and the resulting intestinal putrefaction produce the goiter changes noted in sows that give birth to hairless pigs, and that the disease may be cured by a proper diet and relief of constipation. Changes like those found in myxœdema were noted in the affected animals. Enlargement of the gland is attributed by this author and others to the presence of putrefaction products in the blood by which the gland is overstimulated and which cause it to seek to increase its detoxicating capacity by overgrowth.

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